The Effect of Flexible Retirement on the Marginal Propensity to Consume: Theory and Evidence

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Abstract

This paper studies the effect of flexible retirement on the marginal propensity to consume out of a windfall gain. Using data from the Survey of Consumer Expectations, I find that the MPC of workers is about 20% lower than the MPC of retirees, even when controlling for age and other individual characteristics. In a simple theoretical model, I demonstrate that endogenous retirement can explain this difference in MPCs: Older workers use a part of the windfall to finance early retirement which decreases their consumption response compared to retirees. To quantify this mechanism, I build a life-cycle model with a realistic social security system and durable goods. I find that flexible retirement can account for most of the MPC difference in the data. My results have important implications for the response of aggregate consumption to stock market booms and for the use of MPCs as sufficient statistics in public finance.

JEL codes: D11, D12, D15, E21, J26

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1 Introduction

Why do the consumption expenditures of some households respond very strongly to an unexpected increase in financial resources, while others do not adjust their current spending behavior at all? A large literature[1] tries to identify observable characteristics that can explain the variation in the marginal propensity to consume (MPC) across households. Understanding MPC heterogeneity is important because it can help to distinguish between consumption-savings theories and because of its implications for the design of fiscal stimulus policies.[2] So far, only a few variables have been established as reliable predictors of high MPCs (e.g. liquid wealth), and much of the variation across households remains unexplained.

This paper focuses on the effect of retirement on the marginal propensity to consume out of a windfall gain. Using data from the Survey of Consumer Expectations (SCE), I show that the MPC of older workers in the US is significantly lower than the MPC of retirees of the same age and with similar characteristics. I explore potential explanations for this difference in MPCs both in a simple theoretical framework and in a life-cycle model with a realistic social security system. My main finding is that older workers use a part of the windfall to finance early retirement which decreases their consumption response compared to retirees.

My results are important for two reasons: First, they are crucial for the response of aggregate consumption to stock market fluctuations because older US workers hold a lot of stock market wealth in their defined-contribution plans. Here, it is not the simple average over MPCs which matters, but a weighted average which takes variation in stock market wealth across individuals into account.

Second, MPCs are sometimes used in sufficient statistics formulas, with high MPCs indicating large welfare gains from redistributive policies. For example, Kolsrud et al. (2023) follow such a sufficient statistics approach to compute the consumption smoothing cost of pension reforms that incentivize later retirement. In a model with endogenous retirement however, the reason why older workers tend to have lower MPC than retirees of the same age is not that they value one unit of additional wealth less but that they prefer to use a substantial fraction of the windfall gain to finance early retirement. Therefore, MPCs are no longer informative about the utility gains from financial transfers if the labor supply responses differ across individuals.

Figure 1 illustrates the main empirical finding in its most simple form. It depicts the

[1] See Johnson et al. (2006), Parker et al. (2013), Agarwal and Qian (2014), Misra and Surico (2014), Jappelli and Pistaferri (2014), Kreiner et al. (2019), Fagereng et al. (2021), Gelman (2021).

[2] See Jappelli and Pistaferri (2014), Kaplan and Violante (2014, 2022).

average self-reported MPC of older Americans grouped by age and retirement status. The average MPC among retirees is slightly above 25%, while the average MPC among workers is substantially lower at about 20%. Conditional on retirement status, the average MPC does not vary much with age.

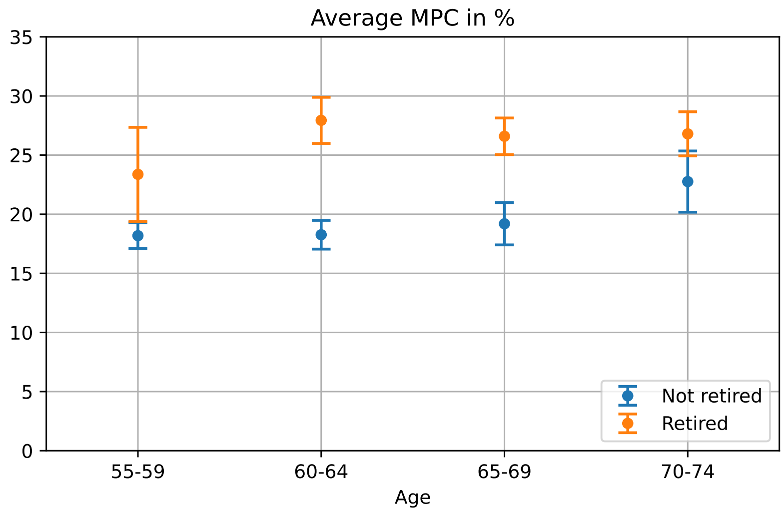

Figure 1: The marginal propensity to consume among older workers and retirees in the Survey of Consumer Expectations. The error bars indicate $\pm$ one standard error.

A possible explanation for the difference in MPCs shown in Figure 1 is that workers decide to retire early based on a characteristic which is also associated with higher MPCs. For example, workers with poor health might retire sooner than their peers and possibly also have higher MPCs due to the shorter planning horizon. Therefore, Section 2 provides a more careful econometric analysis: To identify the difference in MPCs between retirees and workers that cannot be attributed to variation in observable characteristics between the two groups, I regress the self-reported MPC from the Survey of Consumer Expectations on a dummy variable that indicates the retirement status, while controlling for a wide variety of household characteristics. In particular, I include various proxies for the health and the longevity expectations of the survey respondents as control variables. My main finding is that the MPC of a worker is on average about 5 percentage points (or 20%) lower than the MPC of a retiree with similar age, financial wealth, longevity expectations etc. This implies that the gap in MPCs in Figure 1 cannot be explained by differences in observable characteristics between workers and retirees.

In Section 3, I explore two potential ways how retirement can have a direct effect on the MPC in a simple continuous-time model: Agents choose consumption over time and possibly also their retirement age to maximize their lifetime utility subject to a standard budget constraint. Retirement is associated with an increase in leisure but comes at the cost of forgoing labor income. Since the main purpose of the model is to develop an intuition for the possible economic mechanisms, I abstract from details of the pension system and treat labor income and the time of death as deterministic.

First, I consider the case of a fixed retirement age. In this setting, a sufficiently high complementarity between consumption and leisure can decrease both the consumption level and the MPC of older workers relative to the consumption level and the MPC of retirees (mechanism A). However, according to the literature on the retirement consumption puzzle (e.g. Aguila et al., 2011), consumption expenditures do not increase at retirement - if anything, they decrease. Therefore, complementarity between consumption and leisure cannot explain why workers close to retirement have lower MPCs than retirees.

Second, I make retirement age a choice variable and use an additively separable utility function to switch off mechanism A. In this setting, workers use a fraction of the windfall gain to finance early retirement, which dampens the consumption response of workers to such a shock compared to retirees (mechanism B). In contrast to mechanism A, MPC differences associated with flexibility in the retirement age are not associated with differences in consumption levels. For this reason, endogenous retirement age appears to be a plausible explanation for the difference in MPCs across workers and retirees.

To evaluate the strength of mechanism B in a more realistic setting, I calibrate and solve a quantitative life-cycle model with endogenous retirement age in Section 4. Compared to the simple framework from Section 3, there are four main differences: First, the quantitative model features social security benefits which are a function of average past income and retirement age. Second, labor income and the time of death are stochastic. Third, the quantitative model features durable goods. Fourth, it is a discrete-time model with one time period corresponding to one year. Hence, the agents can no longer change their planned retirement age by arbitrarily small increments in response to a windfall gain.

I find that the quantitative model matches the retirement behavior in the data well, including the empirical response of retirement age to windfall gains. The simulated MPC difference between workers and retirees corresponds to either one half or all of the empirical MPC gap, depending on how it is measured. Hence, flexible retirement can indeed explain most of the variation in consumption responses due to retirement status in the SCE data even though it was not targeted in the calibration.

Literature review

This paper builds on Farhi and Panageas (2007) who study optimal consumption-savings behavior and portfolio choice in a theoretical model with endogenous retirement age. They show that in this framework workers close to retirement have a lower MPC than retirees because the increase in financial wealth from a windfall gain is partially offset by a decrease in future labor income due to early retirement (mechanism B according to my terminology).

Relative to Farhi and Panageas (2007), this paper makes the following contributions: 1) It provides empirical evidence which is consistent with the phenomenon described in Farhi and Panageas (2007). 2) Even if retirement age is fixed, sufficiently high complementarity between consumption and leisure can create a gap between the MPC of workers and retirees. This paper describes this alternative mechanism and shows how it can be distinguished from mechanism B. 3) It provides a simple formula that explicitly links the magnitude of the MPC difference to the effect of windfall gains on retirement age. 4) It explores the quantitative relevance of the effect of retirement on the MPC in a life-cycle model with a realistic social security system.

Moreover, this paper is related to two strands of literature. First, a large literature in macroeconomics is concerned with heterogeneity in the MPC. Various approaches to measuring MPCs have emerged: One possibility is to estimate the consumption response to income shocks using data on consumption and income (Parker et al., 2013, Fagereng et al., 2021, Commault, 2022a). The main difficulty of this approach is to identify income changes which are unexpected and transitory. Alternatively, the MPC can be elicited using survey questions which ask respondents to state their consumption response to a hypothetical windfall gain (Jappelli and Pistaferri, 2014, Bunn et al., 2018, Christelis et al., 2019, Fuster et al., 2020). I follow the second approach in this paper and use self-reported MPCs from the Survey of Consumer Expectations in my analysis. Overall, empirical analyses using the two different methods obtain similar results both regarding the average MPC and MPC heterogeneity which validates my empirical approach.

Second, this paper is related to the literature on retirement and consumption. This literature mostly tries to understand if and why consumption expenditures change at the time of retirement (Banks et al., 1998, Aguiar and Hurst, 2005, Aguila et al., 2011). Instead of focusing on changes in consumption levels, this paper is concerned with differences in the MPC, i.e. the first derivative of consumption with respect to available financial resources.

2 Empirical evidence on the MPC of older Americans

Data and methodology

I use data from the Survey of Consumer Expectations (SCE) by the Federal Reserve Bank of New York to analyze the MPC among older workers and retirees in the US.[3] The SCE is a nationally representative online survey of a rotating panel of about 1300 household heads. While the core module of the survey is conducted monthly, other survey modules are conducted less frequently: The Household Spending module which contains self-reported MPCs is fielded in April, August, and December, and the Household Finance module with information on income and wealth is only fielded in August. Therefore, only the August waves of the survey contain all the necessary information to compare the MPCs of workers and retirees with similar socioeconomic characteristics. Since survey respondents rotate out of the panel after twelve months, the final dataset with observations from August only does not have a panel dimension.

The MPC is elicited as follows: The survey participants are supposed to imagine a windfall gain equivalent to 10% of their annual income and are then asked to indicate what share of the extra income they would use to "save or invest / spend or donate / pay down debts".[4] I define the fraction of additional income that the respondent would spend (or donate) in this hypothetical scenario as the self-reported MPC. Unfortunately, the survey question does not explicitly state the relevant time horizon for the MPC. Since the windfall gain is stated relative to annual income, it is natural for survey respondents to think of the fraction of the extra money which they would spend within one year (Commault, 2022b). Therefore, I treat the self-reported MPCs as annual MPCs throughout the paper.

Differences in the MPC between workers and retirees can either be driven by the direct effect of retirement on the MPC or by differences in the composition of the two groups. In order to isolate the effect of retirement on the MPC, I run a linear regression with the self-reported MPC as the dependent variable on year fixed effects, a retirement dummy, and

[3] See Armantier et al. (2017) for more information on the SCE.

[4] To be more precise, the survey question elicits the marginal propensity to *spend* and not the marginal propensity to *consume*. If households only consume non-durable goods, the marginal propensity to spend is equal to the marginal propensity to consume. The two quantities differ however if durable goods are part of the households' consumption baskets. I will nevertheless follow the standard practice in the literature and refer to the marginal propensity to spend as the MPC since no abbreviation for the marginal propensity to spend has been established. The exact wording of the survey question can be found in the appendix (Figure 10).

additional control variables x_i:

$$MPC_i = \sum_{j=2015}^{2019} \alpha_j 1_{j=\text{Year}_i} + \beta\,\text{Retired}_i + \gamma' x_i + \epsilon_i \tag{1}$$

The dummy variable which indicates retirement status is constructed as follows: The Household Finance module contains a survey question about the current employment situation. It is possible to pick more than one option, e.g. respondents can indicate that they are both "working part-time" and see themselves as "retiree[s] or early retiree[s]". In my baseline specification I treat such observations as if the respondent is not retired yet because this strict definition of retirement corresponds better to the models in Sections 3 and 4. For a robustness check, also I construct a less restrictive version of the retirement dummy variable which is always set to 1 if the respondent selects the "retiree or early retiree" option. Moreover, the Household Finance module also contains information on the retirement status of the respondent's spouse which I use in another robustness check.

As control variables I select characteristics of the respondent which are commonly thought to affect either the retirement status or the MPC or both: I include basic demographic variables - age and age squared, a dummy variable that indicates a bachelor's degree or higher, one that indicates the presence of a partner in the household, and one that indicates the gender of the respondent. Moreover, I control for income and financial wealth in a flexible way by including dummy variables for the quartiles of both variables. Income is defined as the total pre-tax income of all household members during the last 12 months, including pensions, social security income, unemployment benefits etc. Financial wealth is defined as the sum of defined contribution plans, individual retirement accounts, and non-retirement savings (savings accounts, stocks, bonds, mutual funds). If the survey respondent has a partner, the financial wealth variable refers to the combined financial wealth of both. Both income and financial wealth are deflated with the CPI before constructing the quartile dummy variables.

The final group of control variables is informative about the health and the longevity expectations of the respondent: self-reported health status as a categorical variable, the quartiles of the proportion of household spending on medical care, and the percent chance to live to age 65, 75, and 85. The designers of the survey intended to ask all participants younger than age X about their probability to live until age X, but due to a coding error in the survey, all three variables about longevity expectations are only available for respondents younger than 65. Table 10 in the appendix shows that the self-reported health status is very informative about subjective longevity expectations.

The final sample spans the years 2015 to 2019 because the question about self-reported

MPCs was introduced in 2015 and because data from the Household Finance module is only available until 2019. I only include respondents who are 55 to 74 years old because I want to focus on older workers who are close to retirement and their already retired peers. The survey data also includes weights to further improve the representativeness of the panel. I estimate the regression model in equation (1) using Weighted Least Squares so that I can take the survey weights into account.

Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Retired	6.17***	5.74***	4.53**	5.65***	6.27**	6.23**	6.70**
	(1.71)	(1.73)	(1.91)	(1.73)	(2.73)	(2.73)	(2.76)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓
Age, age^2	✓	✓	✓	✓	✓	✓	✓
Demographic characteristics		✓	✓	✓	✓	✓	✓
Income and financial wealth		✓	✓	✓	✓	✓	✓
Subjective health			✓				
Health expenditures				✓			
Probability to live to age 65					✓		
Probability to live to age 75						✓	
Probability to live to age 85							✓
Observations	1,963	1,810	1,578	1,810	1,026	1,022	1,010
Adjusted R^2	0.02	0.04	0.04	0.04	0.03	0.03	0.03

Note: *p<0.1; **p<0.05; ***p<0.01

Table 1: Results from a linear regression of the self-reported MPC (in %) on retirement status.

Table 1 shows the main regression results.[5] The first column is the regression counterpart to Figure 1 since only age and year fixed effects are included as control variables. The second regression specification adds demographic variables, income quartiles and financial wealth quartiles. Columns (3) - (7) consider five different proxy variables for health and longevity expectation in addition to the existing control variables. Overall, the effect of retirement on

[5]For better readability, Table 1 omits the estimated coefficients for the control variables. The complete regression table is made available in the appendix (Table 9).

MPC is remarkably stable across different specifications: All point estimates range between 4.5 and 7p.p. and are statistically significant at the 5% level. The results in Table 1 imply that most of the difference in MPCs between workers and retirees cannot be explained away by differences in the composition of the two groups.

Two robustness checks are reported in the appendix. First, Table 7 shows the results with an alternative definition of retirement status: The retirement dummy is set to one for all respondents who see themselves as retirees even if they have not exited the labor force completely yet. The estimates for the effect of retirement on the MPC are somewhat smaller but still significant at the 5% level in specifications (1) - (4).

So far, all regression specifications have considered the retirement status of the survey respondents only. As my second robustness check, I run a regression which takes the retirement status of the respondents' partners into account:

$$MPC_i = \sum_{j=2015}^{2019} \alpha_j 1_{j=\text{Year}_i} + \beta_1 \,\text{One retired}_i + \beta_2 \,\text{All retired}_i + \gamma' x_i + \epsilon_i \tag{2}$$

where "One retired" indicates a couple with one retiree and one person in the labor force and "All retired" either indicates a couple of two retirees or a retiree living without a partner. Table 8 shows results from this alternative specification. The estimated regression coefficients show that the MPC of partially retired households is not significantly different from the MPC of workers, whereas the MPC of fully retired households is considerably larger than in the previously considered specifications which ignore the retirement status of the respondent's partner.

3 Potential mechanisms in a simple framework

Model

In this section, I introduce a simple theoretical framework to illustrate two mechanisms that can generate a lower MPC for workers than for retirees. In order to keep the model analytically tractable, I abstract from details of the pension system, and income, the time of death, and the return on wealth are deterministic. Throughout this paper, I will model retirement as binary decision problem. This is consistent with the empirical evidence reported in Rogerson and Wallenius (2013) who find that the majority of older US males transition from full-time work to not working within one calendar year.

Consider an agent who chooses consumption $c(\tau)$ and retirement age T to maximize

$$\max_{c(\tau),T} \int_t^T e^{-\rho(\tau-t)} u(c(\tau), l_w) d\tau + \int_T^D e^{-\rho(\tau-t)} u(c(\tau), l_r) d\tau \tag{3}$$

subject to the intertemporal budget constraint

$$\int_t^D e^{-r(\tau-t)} c(\tau) d\tau = a(t) + \underbrace{\int_t^T e^{-r(\tau-t)} y(\tau) d\tau}_{=h(t)} \tag{4}$$

where $a(t)$ is financial wealth at time t, $h(t)$ is human wealth, and $y(t)$ is labor income. Moreover, D denotes the time of death, r is the interest rate, ρ is the discount rate, l_w is leisure while working, and l_r is leisure while retired.

The instantaneous utility function is assumed to satisfy $u_c(c,l) > 0$, $u_{cc}(c,l) < 0$, and $u_l(c,l) > 0$. Moreover, I assume $\rho = r$ which implies that consumption is constant at some level c_w during the agent's working life and constant at some level c_r during retirement. For a given retirement age T, consumption levels c_w and c_r are then jointly determined by the first-order condition

$$u_c(c_w, l_w) = u_c(c_r, l_r) \tag{5}$$

and the rewritten intertemporal budget constraint

$$(1 - e^{-r(T-t)})c_w + (e^{-r(T-t)} - e^{-r(D-t)})c_r = r(a(t) + h(t)) \tag{6}$$

Mechanism A: Complementarity between consumption and leisure

Let us first consider the case of a fixed retirement age T. In this case, we can derive the following expression for the MPC of workers ($t < T$) and retirees ($t > T$):

$$MPC_w(t) = \frac{r}{(1 - e^{-r(D-t)}) + \left(\frac{u_{cc}(c_w,l_w)}{u_{cc}(c_r,l_r)} - 1\right)(e^{-r(T-t)} - e^{-r(D-t)})} \tag{7}$$

$$MPC_r(t) = \frac{r}{1 - e^{-r(D-t)}} \tag{8}$$

See appendix A for the derivation. In particular, the MPC just before retirement is

$$MPC_w(T) = \frac{r}{1 - e^{-r(D-T)}} \frac{u_{cc}(c_r, l_r)}{u_{cc}(c_w, l_w)} \tag{9}$$

Therefore, the MPC difference at the time of retirement is determined by the ratio of second derivatives of the utility function with respect to consumption: The MPC of workers is reduced compared to the MPC of retirees if the marginal utility is decreasing more slowly with consumption during retirement than during working life.

To get a more intuitive understanding of how the functional form of the utility function can generate differences in the MPC at the time of retirement, we consider two examples:

First, an interesting special case is a separable utility function $u(c,l) = u_1(c) + u_2(l)$ which implies $u_c(c,l_w) = u_c(c,l_r)$ and $u_{cc}(c,l_w) = u_{cc}(c,l_r)$ for all consumption levels c. Therefore, there is no jump in consumption at the time of retirement $c_w = c_r$ regardless of total wealth $a(t) + h(t)$. Moreover, we can see from equations (8) and (9) that there is no difference in MPCs at the time of retirement.

Second, we consider a nested CRRA-CES utility function

$$u(c,l) = \frac{1}{1-\gamma}\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma}{\rho}} \tag{10}$$

The larger $\gamma > 0$, the less the agent is willing to substitute across time periods. The higher $\rho < 1$, the more the agent is willing to substitute within the same time period.[6]

Intuitively, the change in consumption at retirement is determined by two opposing forces: First, the agent dislikes fluctuations in the consumption-leisure ratio over time because consumption and leisure are complementary to a certain degree. This force tends to increase the consumption level of retirees compared to the consumption level of workers. Second, agents dislike fluctuations in the value of the CES aggregator over time, which tends to increase the consumption level of workers relative to the consumption level of retirees.

In appendix A, I show that for a nested CRRA-CES utility function

$$\begin{aligned}
\gamma + \rho < 1 &\Leftrightarrow c_w < c_r \Leftrightarrow MPC_w(T) < MPC_r(T) \\
\gamma + \rho = 1 &\Leftrightarrow c_w = c_r \Leftrightarrow MPC_w(T) = MPC_r(T) \\
\gamma + \rho > 1 &\Leftrightarrow c_w > c_r \Leftrightarrow MPC_w(T) > MPC_r(T)
\end{aligned} \tag{11}$$

If $\gamma + \rho < 1$, the complementarity between consumption and leisure is more important than to the agent's intertemporal smoothing motive, and therefore a retiree consumes more than a worker. If $\gamma + \rho > 1$, the intertemporal smoothing motive is more important than the complementarity between consumption and leisure, and hence the sign of the consumption difference at retirement switches. Moreover, differences in consumption levels and differences in MPCs are closely connected: If workers consume less than retirees, the MPC of workers close to retirement is lower than the MPC of retirees, and vice versa.

To summarize, we have shown that both the consumption level and the MPC of workers can be lower than the consumption level and the MPC of retirees if the complementarity between consumption and leisure is sufficiently high. But can this mechanism explain the MPC difference found in the SCE data? According to Aguila et al. (2011), there is little

[6] To be more precise, $\rho \to 1$ implies that consumption and leisure are perfect substitutes, and $\rho \to -\infty$ implies that consumption and leisure are perfect complements. The case $\rho \to 0$ corresponds to a Cobb-Douglas aggregator inside a CRRA utility function.

evidence that nondurable consumption expenditures change at the time of retirement in the US. If anything, the literature on the retirement consumption puzzle shows that consumption expenditures decrease rather than increase at retirement. This suggests that the complementarity between consumption and leisure cannot explain why workers close to retirement have lower MPCs than retirees.

Mechanism B: Response of retirement age to a windfall gain

Now we consider the case of endogenous retirement age. In order to turn off mechanism A, we assume an additively separable utility function $u(c,l) = u_1(c) + u_2(l)$ in the following. Without loss of generality, we can write

$$u(c,l) = \begin{cases} u_1(c) - \xi & \text{if } l = l_w \\ u_1(c) & \text{if } l = l_r \end{cases} \tag{12}$$

where $\xi = -u_2(l_w) > 0$ is the disutility of work and $u_2(l_r)$ is normalized to zero. The assumptions that we made about $u(c,l)$ earlier imply $u_1'(c) > 0$ and $u_1''(c) < 0$.

According to the first-order condition (5), optimal consumption is constant over the whole life-cycle for such a utility function. Using the intertemporal budget constraint (6), we can show that consumption $c(t)$, financial wealth $a(t)$ and human wealth $h(t)$ are related as follows:

$$c(t) = \begin{cases} \frac{r}{1-e^{-r(D-t)}}\left(a(t) + h(t)\right) & \text{if } t < T \\ \frac{r}{1-e^{-r(D-t)}} a(t) & \text{if } t > T \end{cases} \tag{13}$$

Differentiating with respect to financial wealth $a(t)$ yields the MPC out of a windfall gain:

$$MPC_w(t) = \frac{r}{1-e^{-r(D-t)}}\left(1 + \frac{dh(t)}{dT}\frac{dT}{da(t)}\right) = \frac{r}{1-e^{-r(D-t)}}\left(1 + e^{-r(T-t)}y(T)\frac{dT}{da(t)}\right) \tag{14}$$

$$MPC_r(t) = \frac{r}{1-e^{-r(D-t)}} \tag{15}$$

Compared to the case of exogenous retirement age, an additional term appears in the expression for the MPC of a worker: The consumption response now depends on the response of human wealth to a windfall gain. If agents decide to retire earlier in response to a wealth shock, i.e. if $dT/da(t) < 0$, the MPC of a worker close to retirement is lower than the MPC of a retiree. In particular, if agents decide to use the complete windfall gain to finance early retirement, i.e. if $dT/da(t) = -e^{r(T-t)}/y(T)$, the MPC of workers becomes zero.

To better understand this mechanism, we now focus on the response of retirement age to a windfall gain. For simplicity, we assume an infinitely-lived agent $D \to \infty$ and mainly rely on a geometric argument in the main text. A mathematical derivation which also applies to agents with a finite lifetime and age-dependent disutility of work can be found in appendix B.

A useful concept is the wealth threshold $\bar{a}(T)$ which is defined as the lowest level financial wealth at which the agent prefers retiring over working. The wealth threshold depends on retirement age T through labor income at the time of retirement $y(T)$. For example, with CRRA utility $u(c) = c^{1-\gamma}/(1-\gamma)$, we have $\bar{a}(T) = (y(T)/\xi)^{1/\gamma}/r$. Intuitively, the incentive to endure the disutility of work ξ for at least one more period is stronger for an agent with high income compared to an agent with low income because the associated increase in future consumption is larger.

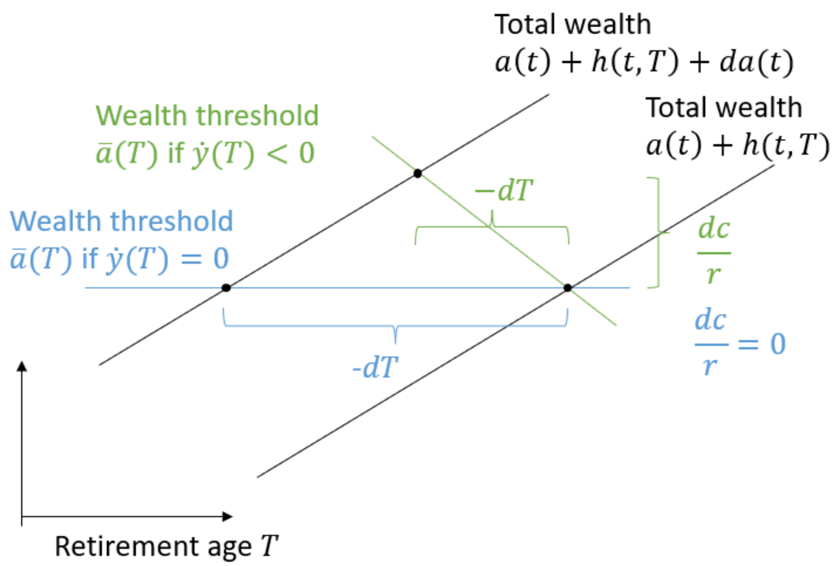

Figure 2: Illustration of mechanism B

In this simple theoretical framework, it is optimal for infinitely-lived households to keep total wealth $a(t) + h(t) = c(t)/r$ constant over time because optimal consumption $c(t)$ is constant. Consequently, optimal retirement age T has to satisfy $\bar{a}(T) = a(t)+h(t,T)$ where I make the dependence of human wealth on retirement age T explicit. Figure 2 shows optimal retirement age as the intersection of total wealth $a(t) + h(t,T)$ and the wealth threshold $\bar{a}(T)$. The blue line represents the special case of a flat wealth threshold due to constant labor income $\dot{y}(T) = 0$ at the time of retirement. The green line shows a declining wealth threshold as a result of decreasing labor income $\dot{y}(T) < 0$.

Figure 2 can be used to analyze the effect of a windfall gain on retirement and consumption. An unexpected increase in financial wealth shifts the total wealth curve upwards by $da(t)$. The responses of retirement age and consumption depend on the slope of the wealth threshold and hence on the slope of the income profile: In the case of a constant wealth threshold (blue line), total wealth says unchanged because the increase in financial wealth is completely offset by a decrease in human wealth by the same amount. In other words, the complete windfall gain is used to retire sooner and none of it is used for consumption. Therefore, the associated reduction in retirement age $-dT$ is large. In the case of decreasing labor income and hence a decreasing wealth threshold (green line), the reduction in retirement age is smaller and total wealth increases which indicates an increase in consumption and hence a positive MPC. As the slope of the wealth threshold goes to $-\infty$, we approach the case of exogenous retirement age: The change in retirement age converges to zero and the MPC converges to r, the MPC of a retiree.

In appendix B, I show that for infinitely-lived agents, the MPC of a worker and the response of retirement age to a windfall gain can be written as

$$\frac{dT}{da(t)} = -\left(\frac{dh(t)}{dT}\right)^{-1} \frac{1}{1+x(t)} = -\frac{e^{r(T-t)}}{y(T)} \frac{1}{1+x(t)} \tag{16}$$

$$MPC(t) = \frac{rx(t)}{1+x(t)} \tag{17}$$

$$x(t) = \left(\frac{dh(t)}{dT}\right)^{-1} \left(-\frac{d\bar{a}}{dT}\right) = \frac{e^{r(T-t)}}{y(T)} \left(-\frac{d\bar{a}}{dT}\right) \tag{18}$$

where mechanism B is stronger for low values of $x(t) > 0$. Equations (16)-(18) confirm the main result from the graphical analysis in Figure 2: The steeper the downward slope of the wealth threshold as a function of age, the larger $x(t)$, and the smaller the responsiveness of retirement age and the MPC difference between workers and retirees. In the special case of CRRA utility, we find

$$x(t) = \frac{1}{\gamma} e^{r(T-t)} \left(\frac{\dot{y}(T)}{y(T)}\right) \frac{\bar{a}}{y(T)} \tag{19}$$

Here, the importance of the slope of the labor income profile becomes explicit. Moreover, the term $e^{r(T-t)}$ indicates that the strength of the mechanism increases the closer the agent is to retirement. Appendix B derives analogous expressions for the finite-lifetime case, but the main conclusions remain unchanged.

To summarize, a model with endogenous retirement age can generate differences between the MPC of workers and retirees without simultaneously creating a gap in their consumption. This stands in contrast to mechanism A which can only decrease the MPC of workers relative to retirees if their consumption becomes lower than that of retirees. For this reason, flexibility in the retirement age appears like a more plausible explanation for the low MPC among workers in the SCE data than complementarity with leisure.

4 MPCs in a quantitative life-cycle model

Baseline model with flexible retirement age

This section considers a quantitative life-cycle model with a realistic social security system, durable goods, and uncertainty about future income and about the time of death. Households choose non-durable consumption, durable goods, savings, the retirement age and the social security claiming age to maximize expected lifetime utility.

Time is discrete and one period corresponds to one year. Households are born at time $t = 0$ and live at most to age $D - 1$. A household survives to the next period $t + 1$ with an age-dependent probability s_{t+1} and dies with probability $1 - s_{t+1}$ at the end of period t.

Preferences are time-separable where β is the discount factor. The instantaneous utility function is $u(c, d, l)$ where c is non-durable consumption, d is durable consumption, and l is the amount of leisure. Workers enjoy l_w units of leisure whereas retirees have $l_r > l_w$ units of leisure. Durable goods have a depreciation rate of δ and the amount of durable goods can be changed without any adjustment frictions.

Workers receive labor income $y_t = \exp(\chi_t + \eta_t + \epsilon_t)$ which has a deterministic life-cycle component χ_t, a persistent component η_t, and a transitory component ϵ_t. The persistent component η_t follows a Markov chain with states $\{\eta_t^i\}$ and transition probabilities $\{\pi_t^{ij}\}$. The transitory component ϵ_t is drawn from a Normal distribution with mean zero and variance σ_ϵ^2. An income tax $\tau(y)$ applies to labor income.

The retirement age of the household is a choice variable and is denoted by T. Households are allowed to retire at any age, but retirement is irreversible, i.e. retirees are not allowed to start working again. The timing in the model is such that workers make their retirement decision after they have learned about the stochastic income realization.

Starting with the early retirement age T_e, retirees can claim social security benefits $y_{ss} = (1 + \phi_{T-T_n})g(\bar{y}^*)$ where $\bar{y}^*$ is the average labor income during the working life, $g(\cdot)$ is a potentially nonlinear function, and ϕ_{T-T_n} denotes the penalty (reward) for claiming social security sooner (later) than the normal retirement age T_n. There is no tax on social security benefits. While the agent is working, average labor income $\bar{y}_t$ in periods $0, \ldots t$ is computed iteratively as follows:

$$\bar{y}_t = \begin{cases} \frac{t}{t+1}\bar{y}_{t-1} + \frac{1}{t+1}y_t & \text{if } t+1 \leq T_{\bar{y}} \\ \frac{T_{\bar{y}}-1}{T_{\bar{y}}}\bar{y}_{t-1} + \frac{1}{T_{\bar{y}}}\max\{y_t, \bar{y}_{t-1}\} & \text{if } t+1 > T_{\bar{y}} \end{cases} \tag{20}$$

After $T_{\bar{y}}$ years, new income realizations are only taken into account if they increase the average income variable. If a worker retires before the minimum number of social security contributions $T_{\bar{y}}$ has been reached, average lifetime income is computed as $\bar{y}^* = (T/T_{\bar{y}})\bar{y}_{T-1}$.

Otherwise, average lifetime income is simply equal to the average income variable from the year before retirement $\bar{y}^* = \bar{y}_{T-1}$.

Households are allowed to save but not to borrow. Savings at the end of period t are denoted by a_t and earn a deterministic return of r. Wealth at the beginning of the next period (including the depreciated durable goods) is $x_{t+1} = (1+r)a_t + (1-\delta)d_t$. All households start their lives without any financial wealth or durable goods at age 0.

Households get utility $u_{beq}(x_t)$ from wealth at the time of death. This is supposed to not only reflect a bequest motive but also other reasons to not dissave quickly during retirement such as high expected medical expenses toward the end of one's life (De Nardi et al., 2016).

The value function of a worker with age t, income state η_t, average income $\bar{y}_t$, and cash-on-hand m_t is denoted by $V_t^w(\eta_t, \bar{y}_t, m_t)$ and the associated Bellman equation is given by:

$$V_t^w(\eta_t, \bar{y}_t, m_t) = \max_{c_t \geq 0,\, d_t \geq 0,\, a_t \geq 0} u(c_t, d_t) - \xi + W_t^w(\eta_t, \bar{y}_t, x_{t+1}) \tag{21}$$

$$\text{s.t. } m_t = c_t + d_t + a_t \tag{22}$$

$$x_{t+1} = (1+r)a_t + (1-\delta)d_t \tag{23}$$

$$W_t^w(\eta_t, \bar{y}_t, x_{t+1}) = \begin{cases} \beta s_{t+1} E[\max\left\{V_{t+1}^w(\eta_{t+1}, \bar{y}_{t+1}, y_{net,t+1} + x_{t+1}), V_{t+1}^r(\bar{y}^*, x_{t+1}) | \eta_t\right\}] & \\ \quad +\beta(1-s_{t+1}) u_{beq}(x_{t+1}) & \text{if } t+1 < T_e \\ \beta s_{t+1} E[\max\left\{V_{t+1}^w(\eta_{t+1}, \bar{y}_{t+1}, y_{net,t+1} + x_{t+1}), V_{t+1}^r(\bar{y}^*, x_{t+1}), V_{t+1}^{ss}(y_{ss}, y_{ss} + x_{t+1})\right\} | \eta_t] & \\ \quad +\beta(1-s_{t+1}) u_{beq}(x_{t+1}) & \text{if } t+1 \geq T_e \end{cases} \tag{24}$$

$$\text{s.t. } \bar{y}_{t+1} = \begin{cases} \frac{t+1}{t+2}\bar{y}_t + \frac{1}{t+2} y_{t+1} & \text{if } t+2 \leq T_{\bar{y}} \\ \frac{T_{\bar{y}}-1}{T_{\bar{y}}}\bar{y}_t + \frac{1}{T_{\bar{y}}} \max\{y_{t+1}, \bar{y}_t\} & \text{if } t+2 > T_{\bar{y}} \end{cases} \tag{25}$$

$$y_{t+1} = \exp(\chi_{t+1} + \eta_{t+1} + \epsilon_{t+1}) \tag{26}$$

$$y_{net,t+1} = y_{t+1} - \tau(y_{t+1}) \tag{27}$$

$$\bar{y}^* = \min\left\{\frac{t+1}{T_{\bar{y}}}, 1\right\} \bar{y}_t \tag{28}$$

$$y_{ss} = (1 + \phi_{t+1-T_n}) g(\bar{y}^*) \tag{29}$$

$$\eta_{t+1} | \eta_t \sim \text{Markov chain} \tag{30}$$

$$\epsilon_{t+1} \sim \text{Normal}(0, \sigma_\epsilon^2) \tag{31}$$

The value function of a retiree with age t, average lifetime income $\bar{y}^*$, and cash-on-hand m_t who has not claimed social security benefits yet is denoted by $V_t^r(\bar{y}^*, m_t)$ and the associated Bellman equation is given by:

$$V_t^r(\bar{y}^*, m_t) = \max_{c_t \geq 0,\, d_t \geq 0,\, a_t \geq 0} u(c_t, d_t) + W_t^r(\bar{y}^*, x_{t+1}) \tag{32}$$

$$\text{s.t. } m_t = c_t + d_t + a_t \tag{33}$$

$$x_{t+1} = (1+r)a_t + (1-\delta)d_t \tag{34}$$

$$W_t^r(\bar{y}^*, x_{t+1}) = \begin{cases} \beta s_{t+1} V_{t+1}^r(\bar{y}^*, x_{t+1}) + \beta(1 - s_{t+1}) u_{beq}(x_{t+1}) & \text{if } t+1 < T_e \\ \beta s_{t+1} \max\left\{V_{t+1}^r(\bar{y}^*, x_{t+1}), V_{t+1}^{ss}(y_{ss}, y_{ss} + x_{t+1})\right\} + \beta(1 - s_{t+1}) u_{beq}(x_{t+1}) & \text{if } t+1 \geq T_e \end{cases} \tag{35}$$

$$\text{s.t. } y_{ss} = (1 + \phi_{t+1-T_n}) g(\bar{y}^*) \tag{36}$$

The value function of a social security recipient with age t, social security benefits y_{ss}, and cash-on-hand m_t is denoted by $V_t^r(y_{ss}, m_t)$ and the associated Bellman equation is given by:

$$V_t^{ss}(y_{ss}, m_t) = \max_{c_t \geq 0,\, d_t \geq 0,\, a_t \geq 0} u(c_t, d_t) + W^{ss}(y_{ss}, x_{t+1}) \tag{37}$$

$$\text{s.t. } m_t = c_t + d_t + a_t \tag{38}$$

$$x_{t+1} = (1+r)a_t + (1-\delta)d_t \tag{39}$$

$$W_t^{ss}(y_{ss}, x_{t+1}) = \beta s_{t+1} V_{t+1}^{ss}(y_{ss}, y_{ss} + x_{t+1}) + \beta(1 - s_{t+1}) u_{beq}(x_{t+1}) \tag{40}$$

Alternative model with fixed retirement age

In order to isolate the effect of flexible retirement on household behavior, it is useful to compare the results of the baseline model with the counterfactual case of a fixed retirement and social security claiming age T_n. In this case, the value function of a worker is given by:

$$V_t^w(\eta_t, \bar{y}_t, m_t) = \max_{c_t \geq 0,\, d_t \geq 0,\, a_t \geq 0} u(c_t, d_t) - \xi + W_t^w(\eta_t, \bar{y}_t, x_{t+1}) \tag{41}$$

$$\text{s.t. } m_t = c_t + d_t + a_t \tag{42}$$

$$x_{t+1} = (1+r)a_t + (1-\delta)d_t \tag{43}$$

$$W_t^w(\eta_t, \bar{y}_t, x_{t+1}) = \begin{cases} \beta s_{t+1} E[V_{t+1}^w(\eta_{t+1}, \bar{y}_{t+1}, y_{net,t+1} + x_{t+1}) | \eta_t] + \beta(1 - s_{t+1}) u_{beq}(x_{t+1}) & \text{if } t+1 < T_n \\ \beta s_{t+1} V_{t+1}^{ss}(y_{ss}, y_{ss} + x_{t+1}) + \beta(1 - s_{t+1}) u_{beq}(x_{t+1}) & \text{if } t+1 = T_n \end{cases} \tag{44}$$

$$\text{s.t. } \bar{y}_{t+1} = \begin{cases} \frac{t+1}{t+2}\bar{y}_t + \frac{1}{t+2} y_{t+1} & \text{if } t+2 \leq T_{\bar{y}} \\ \frac{T_{\bar{y}}-1}{T_{\bar{y}}}\bar{y}_t + \frac{1}{T_{\bar{y}}} \max\{y_{t+1}, \bar{y}_t\} & \text{if } t+2 > T_{\bar{y}} \end{cases} \tag{45}$$

$$y_{t+1} = \exp(\chi_{t+1} + \eta_{t+1} + \epsilon_{t+1}) \tag{46}$$

$$y_{net,t+1} = y_{t+1} - \tau(y_{t+1}) \tag{47}$$

$$y_{ss} = g(\bar{y}_t) \tag{48}$$

$$\eta_{t+1}|\eta_t \sim \text{Markov chain} \tag{49}$$

$$\epsilon_{t+1} \sim \text{Normal}(0, \sigma_\epsilon^2) \tag{50}$$

The value function of a retiree who receives social security benefits $V_t^{ss}(y_{ss}, m_t)$ is the same as in the baseline model.

Calibration

I proceed in two steps to choose the model parameters: First, I set the majority of the parameters according to information from external sources. Second, I calibrate four preference parameters internally with the simulated method of moments. All parameter values are shown in Table 2. One unit of the non-durable consumption good is normalized such that it corresponds to the average gross labor income of agents below the early retirement age. The same holds for one unit of the durable good.

I choose 25 as the age which corresponds to $t = 0$ in the model. Survival rates are taken from the Actuarial Life Table provided by the Social Security Administration.[7] Households in the model live at most $D = 75$ years which corresponds to a maximum age of 100.

I assume that the utility function is additively separable with respect to consumption and leisure $u(c, d, l) = u_1(c, d) + u_2(l)$ based on Aguila et al. (2011) who find no evidence of a change in consumption expenditure at retirement. For the utility over consumption $u_1(c, d)$, I use a Cobb-Douglas utility over non-durable consumption c and durable consumption d nested within an isoelastic utility function. Since the model only allows two possible levels of leisure, l_w and l_r, the utility function over consumption and leisure can be written as

$$u(c, d, l) = \begin{cases} \frac{(c^\alpha d^{1-\alpha})^{1-\gamma}}{1-\gamma} - \xi & \text{if } l = l_w \\ \frac{(c^\alpha d^{1-\alpha})^{1-\gamma}}{1-\gamma} & \text{if } l = l_r \end{cases} \tag{51}$$

where ξ is the disutility of work and $1/\gamma$ is the intertemporal elasticity of substitution. Moreover, I assume an isoelastic utility function for the bequest motive $u_{beq}(x) = \nu x^{1-\gamma}/(1-\gamma)$ where ν denotes the strength of the bequest motive. For the intertemporal elasticity of substitution, I choose the standard value $1/\gamma = 1/2$. The four remaining preference parameters β, α, ν, and ξ are calibrated using the simulated method of moments, which is explained towards the end of this section.

[7]See `https://www.ssa.gov/oact/STATS/table4c6.html`. I compute the average of the survival rates for males and females.

Parameter	Symbol	Value	Source
Maximum age	$D + 25$	100	
Survival rates	$\{s_t\}$		Actuarial life table from SSA
Elasticity of intertemporal substitution	$1/\gamma$	1/2	Standard value
Discount factor	β	0.9378	Simulated method of moments
Strength of bequest motive	ν	17.05	Simulated method of moments
Disutility of work	ξ	0.6382	Simulated method of moments
Durable weight	$1 - \alpha$	0.2259	Simulated method of moments
Income profile	$\{\chi_t\}$		Kaplan and Violante (2010)
Variance of persistent shocks	σ_ζ^2	0.013	Kaplan and Violante (2010)
Variance of transitory shocks	σ_ϵ^2	0.05	Kaplan and Violante (2010)
Lump-sum transfer	τ_0	0.088	Dyrda and Pedroni (2022)
Income tax rate	τ_1	0.225	Dyrda and Pedroni (2022)
Number of years for average income	$T_{\bar{y}}$	35	Social security rules
Early claiming age	$T_e + 25$	62	Social security rules
Normal claiming age	$T_n + 25$	66	Social security rules
Penalty for early claiming	$\{\phi_{T-T_n}\}$	See Table 3	Social security rules
Social security benefits	$g(\bar{y}^*)$	See eq. (52)	Social security rules
Real return on wealth	r	0.06	Jordà et al. (2019)
Durable depreciation rate	δ	0.1855	Beraja and Zorzi (2023)

Table 2: Model parameters.

The deterministic life-cycle component $\{\chi_t\}$ of labor income is taken from Kaplan and Violante (2010). This income profile implies a decrease of median labor income with an annual rate of roughly 8% at age 60, 11% at age 65, and 14% at age 70. For the stochastic component η_t of the income process, I assume a random walk $\eta_t = \eta_{t-1} + \zeta_t$ where the innovation ζ_t is drawn from a Normal distribution with mean zero and variance σ_ζ^2. The random walk is discretized using the generalized Rouwenhorst method described in Fella et al. (2019). The variance of the innovations σ_ζ^2 is chosen to match an increase in the variance of log net income of 0.3 between ages 25 and 55 (Kaplan and Violante, 2010). For the income tax, I assume a linear functional form $\tau(y) = -\tau_0 + \tau_1 y$ where τ_0 is the lump-sum transfer and τ_1 is the tax rate. Both tax parameters are taken from Dyrda and Pedroni (2022).

The parameters of the social security system in the model are chosen to match the existing social security system in the US: The early retirement age is $T_e + 25 = 62$, the minimum number of years for computing average income is $T_{\bar{y}} = 35$, and the formula for social security benefits as a function of average lifetime income is taken from Storesletten et al. (2004):

$$g(\bar{y}^*) = \begin{cases} 0.9\bar{y}^* & \text{if } \bar{y}^* \leq 0.3 \\ 0.27 + 0.32(\bar{y}^* - 0.3) & \text{if } 0.3 < \bar{y}^* \leq 2 \\ 0.81 + 0.15(\bar{y}^* - 2) & \text{if } 2 < \bar{y}^* \leq 4.1 \\ 1.13 & \text{if } 4.1 < \bar{y}^* \end{cases} \tag{52}$$

In the US, both the normal retirement age and the penalty for claiming social security benefits early are gradually increasing with the birth cohort because the US government is trying to incentivize older workers to stay in the labor force for a longer time. For the model, I choose the social security rules which apply for the birth cohorts 1943-1954[8]: $T_n + 25 = 66$ is the normal retirement age and the penalty (reward) for retiring early (late) is given in Table 3.[9]

Retirement age T	62	63	64	65	66	67	68	69	≥ 70
$T - T_n$	-4	-3	-2	-1	0	1	2	3	≥ 4
ϕ_{T-T_n}	-25%	-20%	-13.3%	-6.7%	0%	8%	16%	24%	32%

Table 3: Percentage change of social security benefits in the case of early and late retirement.

The return on wealth $r = 0.06$ is set equal to the annual real return on the average household portfolio in the US from Jordà et al. (2019). The durable depreciation rate is taken from Beraja and Zorzi (2023). The definition of durables both in my model and in Beraja and Zorzi (2023) does not include housing.

In a final step, the discount factor β, the disutility of work ξ, the strength of the bequest motive ν, and the durable weight $1 - \alpha$ are jointly calibrated with the simulated method of moments. The first targeted moment is the average wealth (including housing wealth) of 273 000 dollars in the SCE data which corresponds to 3.6 units of the nondurable good in the model. The second moment is the speed of wealth decumulation during retirement: Median wealth in the 70-74 age group is roughly 10% lower than median wealth in the 65-69 age group. These two moments summarize wealth dynamics over the life-cycle concisely and are informative about the discount factor β and the strength of the bequest motive ν. The third moment is the fraction of retirees at age 65 which is approximately 50% in the SCE data.

[8]The MPC data analyzed in Section 2 covers 55- to 74-year-olds during the years 2015-2019, i.e. birth cohorts 1941-1964.

[9]See `https://www.ssa.gov/benefits/retirement/planner/1943.html` and `https://www.ssa.gov/benefits/retirement/planner/1943-delay.html`.

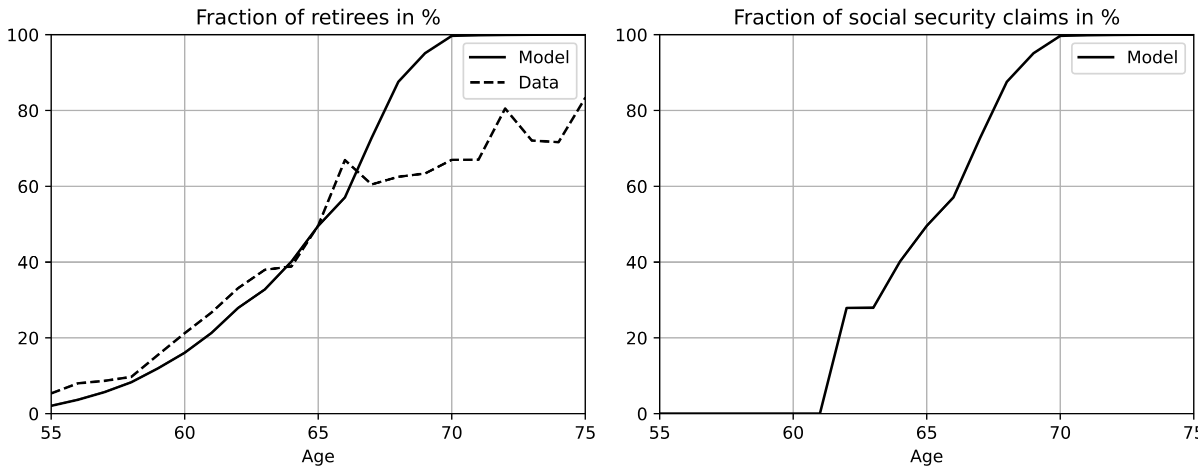

Figure 3: Simulated retirement and social security claiming behavior.

This moment is particularly informative about the disutility of work. The fourth moment is a share of durable expenditures of 21% (Beraja and Zorzi, 2023) which is most relevant for the choice of the durable weight $1 - \alpha$ in the utility function. The resulting estimates for β, ξ, ν, and $1 - \alpha$ are shown in Table 2.

Retirement behavior

Before computing the MPCs, I check the simulated retirement behavior to validate the model. The left panel of Figure 3 compares the simulated fraction of retirees at each age to data from the Survey of Consumer Expectations.[10] While the calibration targets a fraction of 50% retirees at the age of 65, it does not restrict the simulated fraction of retirees at any other age. The model matches the actual retirement behavior almost perfectly up to age 67 but underestimates the fraction of workers at older ages.

The right panel of Figure 3 shows the simulated social security claiming behavior. Unfortunately, the Survey of Consumer Expectations does not feature a question on whether the respondents have claimed benefits. Therefore, I have to rely on data from other sources: According to data from the Health and Retirement Study analyzed in Bairoliya and McKiernan (2021), the most common claiming age is 62, which is also the earliest possible claiming age. This is also the case for the model simulations.

The theoretical analysis in Section 3 has shown that there is a tight relationship between the response of retirement age to a windfall gain and the reduction in the marginal propensity

[10] As in Section 2, I use a strict definition of retirement: Respondents who view themselves as retirees but work part-time are not categorized as retirees.

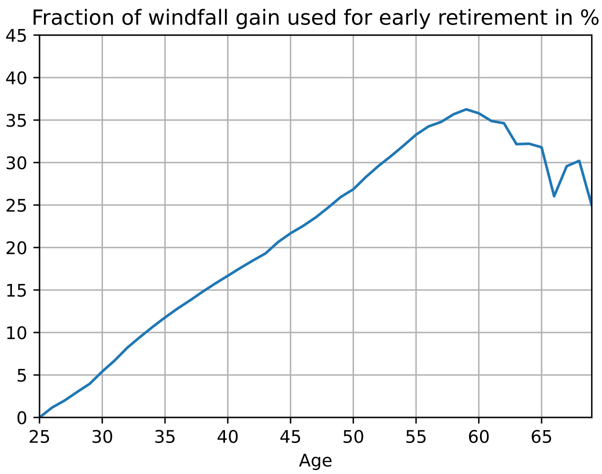

Figure 4: Fraction of windfall gain used to finance early retirement as a function of age at the time of receipt. Agents who are already retired when they receive the windfall gain are ignored in this calculation.

to consume among workers. Therefore, I also compare the empirical evidence on retirement behavior after a wealth shock to the implications of the model.

Figure 4 shows that the fraction of a windfall gain that is used to finance early retirement increases from 0% at age 25 to almost 40% at age 60. Between ages 60 and 70, this fraction decreases slightly to about 30%.[11] Golosov et al. (2021) use administrative data on US lottery winners to study the allocation of windfall gains over time and find that about 50% of lottery wins are used to reduce labor supply. Since this number includes margins of labor supply other than the binary retirement decision, it can only be viewed as an upper bound for the fraction used for early retirement.

	Model	Golosov et al. (2021)		
	Retirement	One-Year Exit	Two-Year Exit	Five-Year Exit
Estimate	0.0593	0.0489	0.0536	0.0490
Standard Error	-	(0.0053)	(0.0058)	(0.0098)
Counterfactual Mean	0.40	0.43	0.40	0.35
Percentage Change	14.8	11.3	13.4	14.0

Table 4: Effect of windfall gain on labor market exit: Model simulations vs. empirical results in Golosov et al. (2021).

[11]The wealth shock considered here is 10% of net income, as for the computation of the MPC later on. However, the results do not change much as I vary the size of the windfall gain.

Golosov et al. (2021) also estimate the effect of windfall gains on labor market exit for lottery winners aged 62-64. Table 4 reports the empirical results in Golosov et al. (2021) for one-year, two-year and five-year exits as well as the simulated effect of a windfall gain on the transition into retirement (i.e. irreversible labor market exit). I follow the methodology from Golosov et al. (2021) as closely as possible: I consider a windfall gain of 100 000 dollars which corresponds to 1.33 units of the consumption good in the model. The point estimate refers to the change of the exit rate due to the windfall gain, averaged over years 1-5 following the receipt of the windfall gain. The counterfactual mean corresponds to the fraction of workers who would have exited the labor market in the absence of a windfall gain. Overall, the simulated effect of a windfall gain on retirement age matches the empirical results in Golosov et al. (2021) well.

Marginal propensity to consume of workers and retirees

In the model, I compute MPCs as follows: For each age t and each agent i, I consider the counterfactual situation in which the agent has cash-on-hand $m'_{it} = m_{it} + \Delta m_{it}$ instead of the "regular" cash-on-hand level m_{it}. The MPCs of workers and retirees are then defined as

$$MPC^w_{it} = \frac{c^w_t(\eta_{it}, \bar{y}_{it}, m'_{it}) + d^w_t(\eta_{it}, \bar{y}_{it}, m'_{it}) - c^w_t(\eta_{it}, \bar{y}_{it}, m_{it}) - d^w_t(\eta_{it}, \bar{y}_{it}, m_{it})}{\Delta m_{it}} \tag{53}$$

$$MPC^r_{it} = \frac{c^r_t(\bar{y}_{it}, m'_{it}) + d^r_t(\bar{y}_{it}, m'_{it}) - c^r_t(\bar{y}_{it}, m_{it}) - d^r_t(\bar{y}_{it}, m_{it})}{\Delta m_{it}} \tag{54}$$

$$MPC^{ss}_{it} = \frac{c^{ss}_t(y_{ss,it}, m'_{it}) + d^{ss}_t(y_{ss,it}, m'_{it}) - c^{ss}_t(y_{ss,it}, m_{it}) - d^{ss}_t(y_{ss,it}, m_{it})}{\Delta m_{it}} \tag{55}$$

where $c^w_t(\eta, \bar{y}, m)$, $c^r_t(\bar{y}, m)$, and $c^{ss}_t(y_{ss}, m)$ are the nondurable consumption policy functions for workers, retirees without social security and retirees with social security, respectively. $d^w_t(\eta, \bar{y}, m)$, $d^r_t(\bar{y}, m)$, and $d^{ss}_t(y_{ss}, m)$ are the associated policy functions for durable consumption. Analogous to the survey question in the SCE, I consider a windfall gain which corresponds to 10% of the annual net income, i.e. $\Delta m_{it} = 0.1(y^{net}_{it} + ra_{it-1})$.

Figure 5(i) and Table 5 present the main results in the quantitative model in the same way as the empirical results were presented in Section 2. Figure 5(i) shows the average MPC for workers and retirees in the age groups 55-59, 60-64, 65-69, and 70-74. The MPCs of workers are about 2-3 percentage points lower than the MPCs of similarly-aged retirees which corresponds to about one third to one half of the empirical MPC gaps in Figure 1.

Table 5 presents the results of regressions of the simulated MPCs on a retirement dummy and control variables. Some control variables from the empirical results in Section 2 do not have a counterpart in the model and are therefore left out. In a regression with age controls only, I obtain an MPC difference of 2.5 p.p. When I add dummies for income and

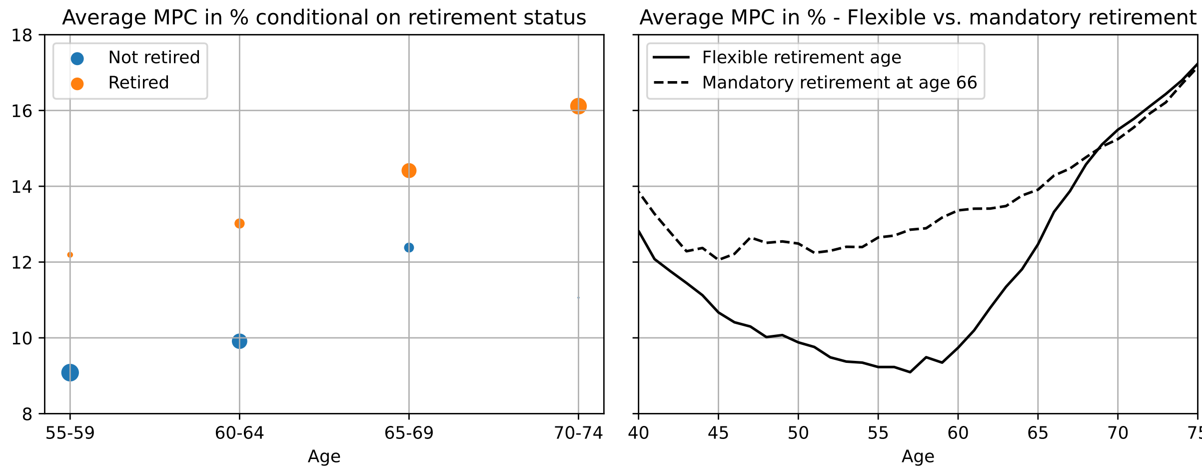

Figure 5: Simulated MPCs in the quantitative life-cycle model. (i) Mean MPC conditional on age and retirement status. The size of the dots is proportional to the number of simulated agents in a certain group. See Figure 1 for a comparison with the empirical MPCs. (ii) Mean MPC conditional on age but not retirement status, both for the baseline version of the model (flexible retirement) and for a mandatory retirement age $T_n = 66$.

wealth quartiles to the regression, I can match the empirical MPC difference of about 5 p.p. almost perfectly. Consequently, the quantitative model shows that flexible retirement can either explain one half or all of the empirical MPC gap, depending on how the MPC gap is measured.

Panel (ii) of Figure 5 compares the baseline results to MPCs generated in a model with a fixed retirement age $T_n = 66$. I find that flexibility in the retirement age decreases the average MPC in the 55-60 age range by about 3 p.p. compared to the mandatory retirement benchmark. But even for agents as young as 40 the quantitative model still predicts a sizable reduction in the average MPC due to flexible retirement.

Figure 6 shows the MPC gap as a function of the distance to retirement: Flexible retirement reduces the MPC by 6 p.p. in the period before retirement and by about 3 p.p. 10 years before retirement. These numbers hide substantial heterogeneity by retirement age: The right panel of Figure 6 shows large effects of retirement flexibility on the MPC for workers who retire before or at the normal retirement age 66, and significantly smaller reductions for workers who retire later.

	(1)	(2)
Retired	2.50***	5.17***
	(0.02)	(0.03)
Age, age^2	✓	✓
Income quartiles		✓
Wealth quartiles		✓
Observations	1,691,346	1,691,346
Adjusted R^2	0.07	0.13
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 5: Results from a linear regression of the simulated MPCs (in %) on retirement status. See Table 1 for a comparison with the empirical MPCs.

MPC level and the role of durable goods

While the model simulations match the empirical MPC gap relatively well, the overall level of the simulated MPCs is substantially lower than for empirical MPCs: For example, the average MPC of retirees aged 65-69 in the model simulations is about 14%, which is approximately one half of the MPC level in the data. This is not surprising because the model neither includes illiquid assets nor present bias, which are two popular explanations for the large consumption responses in the data (Kaplan and Violante, 2022).

The only feature of the quantitative model that brings the simulated MPCs closer to their empirical counterparts are durable goods. Intuitively, the expenditures associated with durable goods are more front-loaded which increases the MPCs.

To better understand the role of durable goods for the level of MPCs and for the size of the MPC gap, I consider a version of the model without durable goods. This can be achieved by setting the preference weight on durable goods $1-\alpha$ to zero. Figure 13 and Table 11 in the appendix present the results for this special case. Both the level of MPCs and the gap between workers and retirees is higher in the model with durable goods than in the version of the model with $1-\alpha=0$. For example, the average MPC of retirees aged 65-69 is only 9% without durable goods and 14% with durable goods. The effect of retirement on MPCs, as measured by the second regression specification, is 2.7% without durable goods and 5.1% with durable goods.

Laibson et al. (2022) analyze how the introduction of durable goods affects MPCs. For

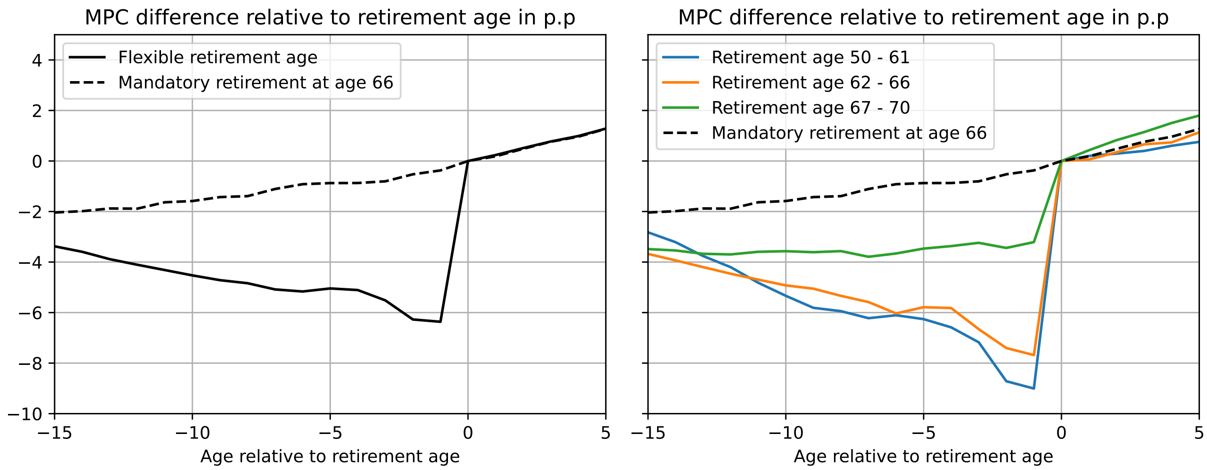

Figure 6: MPC difference relative to retirement age in percentage points. See Figure 11 for the difference in %.

a simple consumption-savings model, they derive the following mapping between the MPC in a model without durable goods MPC_{nondur} and the MPC in a model with durable goods MPC_{dur}:

$$MPC_{\text{dur}} = \left(1 - s + \frac{s}{r+\delta}\right) MPC_{\text{nondur}} \tag{56}$$

where s is the durable share, r is the real interest rate and δ denotes the durable depreciation rate. While the mapping does no longer hold precisely in the model with a realistic retirement system considered here, it does provide a good approximation: With the parameters used in the calibration, I get

$$1 - s + \frac{s}{r+\delta} \approx 1.68 \tag{57}$$

If I multiply the MPCs without durable goods in Figure 13 with that factor, I almost obtain the same MPCs as in Figure 5.

Implication I: Transmission of shocks to aggregate consumption

How important is flexible retirement for the transmission of income and wealth shocks to aggregate consumption? My analysis so far only shows that the endogenous retirement decision significantly reduces the consumption responses of households close to retirement, but it is not clear yet if and under which circumstances it is quantitatively relevant at the macro level.

To answer this question, I compute the response of aggregate consumption to different types of shocks in partial equilibrium both for the baseline version of the model and for

Shock	$\Delta c/c$ (Flex. ret.)	$\Delta c/c$ (Mand. ret.)	Rel. diff.	Rel. diff. (Age < 70)
$\Delta w_{it} = 0.01$	0.287%	0.295%	-2.8%	-4.0%
$\Delta w_{it} = 0.01 \cdot w_{it}/\bar{w}$	0.142%	0.164%	-13.3%	-22.3%
$\Delta w_{it} = 0.1$	2.774%	2.857%	-2.9%	-4.2%
$\Delta w_{it} = 0.1 \cdot w_{it}/\bar{w}$	1.424%	1.643%	-13.5%	-22.4%

Table 6: Aggregate consumption response to wealth shocks both in the baseline model with flexible retirement age and in the model with a mandatory retirement age of 66. The proportional wealth shocks are scaled in such a way that their aggregate size is the same as for the corresponding constant wealth shocks. $w_{it} = (1 + r)a_{it-1}$ denotes the wealth of a household (excluding the stock of durable goods) and $\bar{w}$ denotes the average wealth in the economy.

the version with a mandatory retirement age. Table 6 summarizes the main results.[12] For windfall gains that increase the available financial resources of all agents by the same amount, the dampening effect of retirement flexibility is not quantitatively important: The response of aggregate consumption only decreases by about 3% if I allow for flexible retirement. On the other hand, flexible retirement reduces the response of aggregate consumption by more than 13% for windfall gains that are proportional to existing wealth. Examples for shocks which are approximately proportional to household wealth are stock market booms and unexpected increases in house prices. The importance of the endogenous retirement decision for aggregate consumption does not vary much with the size of the windfall gains.

One important caveat is that the MPCs of retirees increase with age in the quantitative model (see Figure 5) whereas this is not the case in the data (see Figure 1). Hence, a disproportionally large share of the simulated consumption response is due to old retirees. Excluding agents with age 70 and older from the computation of the aggregate consumption response increases the effect of flexible retirement to -4% for constant wealth shocks to -22% for proportional wealth shocks.

Intuitively, it makes a lot of sense that retirement flexibility plays a bigger role for the transmission of shocks which are proportional to existing wealth: Households close to retirement have accumulated more wealth than any other age group. Moreover, stock market wealth is probably even more concentrated in the 50-65 age group than total wealth because of the importance of 401k plans and individual retirement accounts for retirement savings.

[12] The relative difference which measures the role of a flexible retirement age stays unchanged if I multiply all individual consumption responses by a constant factor. Therefore, the inability of the model to match the level of MPCs is not a big concern for this exercise.

Therefore, the dampening effect of endogenous retirement on the aggregate consumption response might be even more relevant for stock market booms than what is implied by the results in Table 6.

Implication II: MPCs as sufficient statistics

A recent literature in public finance (e.g. Landais et al., 2021, Kolsrud et al., 2023) uses MPCs as sufficient statistics to evaluate redistributive policies. The idea behind this approach is that high MPCs indicate large utility gains from additional financial resources. Since retirees tend to have higher MPCs than workers according to the SCE data, a naive application of the sufficient statistics approach would imply that redistribution from workers to retirees increases utilitarian social welfare.

In order to check whether this prediction is indeed true, I implement the following transfer from workers to retirees: I take $n_t/n_t^w \cdot \Delta$ units of the consumption good from each worker of age t and give $n_t/n_t^r \cdot \Delta$ units of the consumption good to each retiree of age t. n_t^w and n_t^r denote the number of workers and retirees of age t, respectively, and $n_t = n_t^w + n_t^r$ is the total number of agents of age t. Then I compute the amount Δ_t^{eq} which needs to be given all agents of age t to achieve the same level of utilitarian welfare as without the wealth transfer. I define the welfare gain as the ratio Δ_t^{eq}/Δ. For the numerical exercise, I choose $\Delta = 0.01$ but since my measure of the welfare gain is normalized by the size of the transfer, it barely changes as I vary Δ.

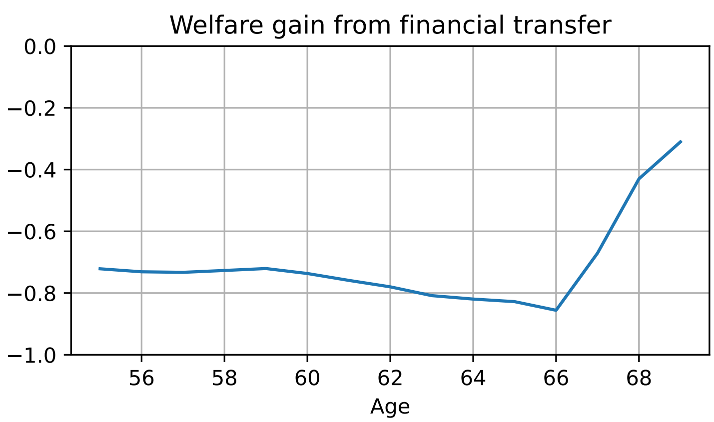

Figure 7: Welfare gain Δ_t^{eq}/Δ from a wealth transfer from workers to retirees. See the main text for detailed information about the wealth transfer and the computation of the welfare gain.

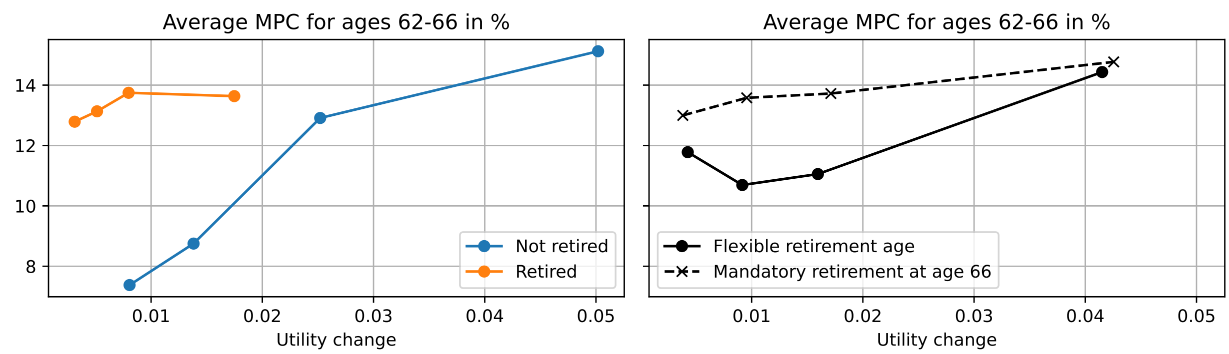

Figure 8: Binscatter plot of utility change from 0.01 additional wealth and MPCs for age group 62-66.

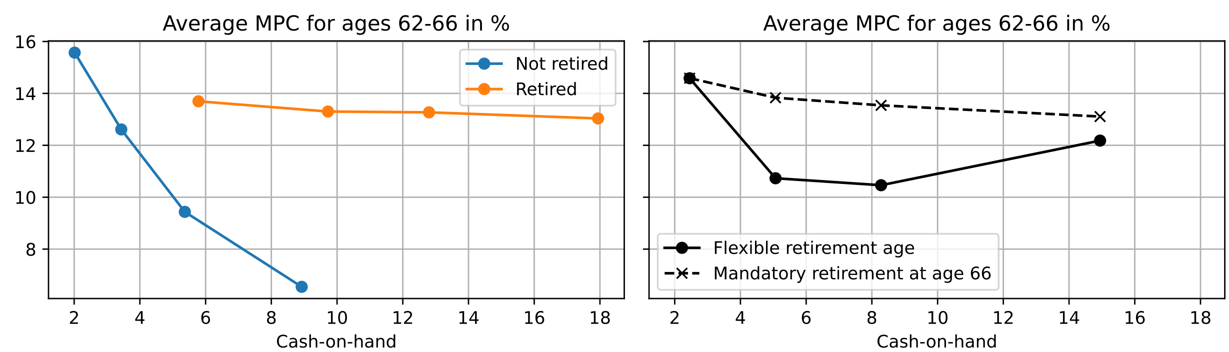

Figure 9: Binscatter plot of wealth and MPCs for age group 62-66.

Figure 7 shows the welfare gains Δ_t^{eq}/Δ for ages $t = 55, \ldots 69$.[13] The main finding is that the redistributive transfer generates welfare losses, contrary to the prediction from the sufficient statistics approach. The welfare losses are large relative to the size of the transfer: For ages 55-66, each unit of the consumption good which transferred to retirees is equivalent to decreasing the wealth of all agents of this age by 0.7-0.8 units. For ages 67-69, the magnitude of the welfare loss relative to the size of the transfer decreases quickly with age.

Why does redistribution from low-MPC workers to high-MPC retirees not increase social welfare in the quantitative model? Intuitively, older workers do not have a lower MPC than retirees of the same age because they value one unit of additional wealth less but because they prefer to use a substantial fraction of the windfall gain to finance early retirement. Therefore, comparing the average MPC across the two groups is not informative about the welfare gains of a redistributive policy.

[13] All agents in the quantitative model are retired at age 70, therefore it is not possible to conduct the wealth transfer with agents who are 70 years old or older.

To formalize this argument, Figure 8 shows a binscatter plot with the utility change from a 0.01 wealth transfer on the x-axis and the MPC on the y-axis. The left panel shows that MPCs and the utility gain have a strong positive correlation conditional on retirement status. However, retirees with a certain utility gain from additional wealth have a much higher MPC than workers with the same utility gain because endogenous retirement decreases the MPC of workers who are close to retirement. For this reason, the monotonous positive relationship between MPCs and the utility gain vanishes once we do no longer condition on retirement status in the right panel. A similar pattern can be observed in the relationship between MPCs and wealth which is depicted in Figure 9.

5 Conclusion

In this paper, I document that the self-reported MPC of older workers is substantially lower than the MPC of retirees and consider three possible explanations: 1) Individuals with poor health and low longevity expectations may retire earlier and also have higher MPCs than their peers. 2) Sufficiently high complementarity between consumption and leisure can generate a gap between the MPC of workers and retirees. 3) Older workers use part of a windfall gain to finance early retirement which reduces their MPC.

According to the empirical analysis in section 2, a possibly lower life expectancy among retirees cannot be the main explanation for the gap in MPCs. Moreover, the empirical evidence on the change of consumption expenditures at retirement is at odds with the predictions of an explanation based on complementarity of consumption and leisure. Using both a simple theoretical model and a quantitative life-cycle model, I show that the response of retirement age to windfall gains is the most plausible explanation: The results of the quantitative model (which only allows for explanation 3) are roughly consistent with the MPC difference in the SCE data of 5 percentage points.

This project has ignored all margins of labor supply other than a binary retirement decision. In future research, I plan to study the effect of labor supply responses on the MPC in a more general setting.

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A Mechanism A: Derivations

Derivation of equation (7)

Apply implicit differentiation with respect to financial wealth $a(t)$ both to the first-order condition (5) and to the intertemporal budget constraint (6):

$$u_{cc}(c_w, l_w)\frac{dc_w}{da(t)} = u_{cc}(c_r, l_r)\frac{c_r}{da(t)} \tag{58}$$

$$(1 - e^{-r(T-t)})\frac{c_w}{da(t)} + (e^{-r(T-t)} - e^{-r(D-t)})\frac{c_r}{da(t)} = r \tag{59}$$

In the next step, rearrange (58) for $dc_r/da(t)$ and plug the resulting expression into (59):

$$(1 - e^{-r(T-t)})\frac{c_w}{da(t)} + (e^{-r(T-t)} - e^{-r(D-t)})\frac{u_{cc}(c_w, l_w)}{u_{cc}(c_r, l_r)}\frac{c_w}{da(t)} = r \tag{60}$$

Rearranging (60) for $dc_w/da(t)$ yields the MPC of workers in equation (7).

Derivation of equation (11)

Consider the CRRA-CES utility function and its derivatives:

$$u(c, l) = \frac{1}{1-\gamma}\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma}{\rho}} \tag{61}$$

$$u_c(c, l) = \alpha c^{\rho-1}\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma-\rho}{\rho}} \tag{62}$$

$$u_l(c, l) = (1-\alpha)l^{\rho-1}\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma-\rho}{\rho}} \tag{63}$$

$$\begin{aligned} u_{cc}(c, l) &= \alpha(\rho-1)c^{\rho-2}\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma-\rho}{\rho}} \\ &\quad + \alpha^2(1-\gamma-\rho)c^{2\rho-2}\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma-2\rho}{\rho}} \end{aligned} \tag{64}$$

$$= -\alpha c^{\rho-2}(\alpha\gamma c^{\rho} + (1-\alpha)(1-\rho)l^{\rho})\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma-2\rho}{\rho}} \tag{65}$$

$$u_{cl}(c, l) = \alpha(1-\alpha)(1-\gamma-\rho)c^{\rho-1}l^{\rho-1}\left(\alpha c^{\rho} + (1-\alpha)l^{\rho}\right)^{\frac{1-\gamma-2\rho}{\rho}} \tag{66}$$

where $\rho < 1$, $\gamma > 0$ and $0 < \alpha < 1$. It is easy to see that the marginal utilities $u_c(c, l)$ and $u_l(c, l)$ are positive for all possible combinations of consumption $c > 0$ and leisure $l > 0$ and that the second derivative $u_{cc}(c, l)$ is always negative. The sign of the cross-derivative $u_{cl}(c, l)$ depends on $\gamma + \rho \lesseqgtr 1$:

$$\begin{aligned} &\gamma + \rho < 1 \Leftrightarrow u_{cl}(c, l) > 0\ \forall c > 0,\ l > 0 \Leftrightarrow c \text{ and } l \text{ are q-complements} \\ &\gamma + \rho = 1 \Leftrightarrow u_{cl}(c, l) = 0\ \forall c > 0,\ l > 0 \Leftrightarrow \text{additively separable utility function} \\ &\gamma + \rho > 1 \Leftrightarrow u_{cl}(c, l) < 0\ \forall c > 0,\ l > 0 \Leftrightarrow c \text{ and } l \text{ are q-substitutes} \end{aligned} \tag{67}$$

The relationship $\gamma + \rho \lesseqgtr 1 \Leftrightarrow c_w \lesseqgtr c_r$ follows directly from equation (67) combined with $u_c(c,l) > 0$, $u_{cc}(c,l) < 0$.

The remainder of the derivation concerns the MPCs of workers and retirees. From equation (9) we know that MPCs are closely related to the second derivative of the utility function with respect to consumption:

$$MPC_w(T) \gtrless MPC_r(T) \Leftrightarrow \frac{u_{cc}(c_r, l_r)}{u_{cc}(c_w, l_w)} \gtrless 1 \tag{68}$$

The second derivative can be expressed in terms of the first derivative

$$\begin{aligned} u_{cc}(c,l) &= -u_c(c,l)\left((1-\rho)c^{-1} + \alpha(\gamma+\rho-1)c^{-(1-\rho)}(\alpha c^\rho + (1-\alpha)l^\rho)^{-1}\right) & (69) \\ &= -u_c(c,l)c^{-1}\left((1-\rho) - \alpha(1-\gamma-\rho)c^\rho(\alpha c^\rho + (1-\alpha)l^\rho)^{-1}\right) & (70) \end{aligned}$$

- Case $\gamma + \rho > 1$ and $\gamma > 1$: Using equation (69), we know that $MPC_w(T) > MPC_r(T)$ holds if

$$\frac{(1-\rho)c_r^{-1} + \alpha(\gamma+\rho-1)c_r^{-(1-\rho)}(\alpha c_r^\rho + (1-\alpha)l_r^\rho)^{-1}}{(1-\rho)c_w^{-1} + \alpha(\gamma+\rho-1)c_w^{-(1-\rho)}(\alpha c_w^\rho + (1-\alpha)l_w^\rho)^{-1}} > 1 \tag{71}$$

  Note that the terms related to the first derivative cancel due to the first-order condition. Both the numerator and the denominator are a sum of two positive terms with the same structure. The first term is greater in the numerator than in the denominator because $c_w > c_r$ holds in this part of the parameter space. In order to see why the second term is also greater in the numerator than in the denominator, we need to rearrange the first-order condition:

$$\begin{aligned} \left(\frac{c_r}{c_w}\right)^{1-\rho} &= \left(\frac{\alpha c_r^\rho + (1-\alpha)l_r^\rho}{\alpha c_w^\rho + (1-\alpha)l_w^\rho}\right)^{\frac{1-\gamma-\rho}{\rho}} & (72) \\ \Leftrightarrow \left(\frac{c_r}{c_w}\right)^{-\frac{(1-\rho)\rho}{1-\rho-\gamma}} &= \left(\frac{\alpha c_r^\rho + (1-\alpha)l_r^\rho}{\alpha c_w^\rho + (1-\alpha)l_w^\rho}\right)^{-1} & (73) \\ \Leftrightarrow \left(\frac{c_r}{c_w}\right)^{\frac{(1-\rho)(\gamma-1)}{1-\rho-\gamma}} &= \frac{c_r^{-(1-\rho)}}{c_w^{-(1-\rho)}}\left(\frac{\alpha c_r^\rho + (1-\alpha)l_r^\rho}{\alpha c_w^\rho + (1-\alpha)l_w^\rho}\right)^{-1} > 1 & (74) \end{aligned}$$

  The inequality sign in the last equation follows from $c_w > c_r$ and $\frac{(1-\rho)(\gamma-1)}{1-\rho-\gamma} < 0$ in this region of the parameter space. Consequently, we have indeed shown that $MPC_w(T) > MPC_r(T)$ holds in this region of the parameter space.

- Case $\gamma + \rho < 1$ and $\rho < 0$: Using equation (70), we know that $MPC_w(T) < MPC_r(T)$ holds if

$$\frac{c_r^{-1}}{c_w^{-1}} \cdot \frac{(1-\rho) - \alpha(1-\gamma-\rho)c_r^\rho(\alpha c_r^\rho + (1-\alpha)l_r^\rho)^{-1}}{(1-\rho) - \alpha(1-\gamma-\rho)c_w^\rho(\alpha c_w^\rho + (1-\alpha)l_w^\rho)^{-1}} < 1 \tag{75}$$

Again, the terms related to the first derivative cancel due to the first-order condition. Both terms of the product on the left-hand side of the equation above are positive. The first term of the product is smaller than one because $c_w < c_r$ holds in this part of the parameter space. In order to see why the second term is also smaller than one, we need to rearrange the first-order condition:

$$\left(\frac{c_r}{c_w}\right)^{-\frac{\gamma\rho}{1-\rho-\gamma}} = \frac{c_r^\rho}{c_w^\rho}\left(\frac{\alpha c_r^\rho + (1-\alpha)l_r^\rho}{\alpha c_w^\rho + (1-\alpha)l_w^\rho}\right)^{-1} > 1 \tag{76}$$

The inequality sign follows from $c_w < c_r$ and $-\frac{\gamma\rho}{1-\rho-\gamma} > 0$ in this region of the parameter space. Consequently, we have indeed shown that $MPC_w(T) < MPC_r(T)$ holds in this region of the parameter space.

B Mechanism B: Derivations

The theoretical model considered here is more general than the example in the main text: In contrast to the example in section 3, the subsequent results allow for agents with a finite lifetime D and the disutility of work ξ can vary with age t. Whenever it is necessary to make assumptions about the functional form of $u_1(\cdot)$ in (12), I assume CRRA utility $u_1(c) = c^{1-\gamma}/(1-\gamma)$.

Optimal retirement age for given consumption

Objective function (3) with utility function (12), optimal consumption (13), and $\rho = r$ plugged in:

$$\max_T \frac{1-e^{-r(D-t)}}{r} u_1(c(t)) - \int_t^T e^{-r(\tau-t)}\xi(\tau)d\tau \tag{77}$$

First-order condition with respect to retirement age T:

$$\frac{1-e^{-r(D-t)}}{r} u_1'(c(t))\frac{dc(t)}{dT} = e^{-r(T-t)}\xi(T) \tag{78}$$

- Left-hand side: marginal benefit of postponing retirement by dT (as seen from time t)
- Right-hand side: marginal cost of postponing retirement by dT (as seen from time t)

Effect of retirement age on consumption:

$$\frac{dc(t)}{dT} = \frac{r}{1-e^{-r(D-t)}}\frac{dh(t)}{dT} = \frac{r}{1-e^{-r(D-t)}}e^{-r(T-t)}y(T) \tag{79}$$

Plug (79) into (78) to obtain simplified optimality condition for T:

$$u_1'(c(t))y(T) = \xi(T) \tag{80}$$

Derive the wealth threshold $\bar{a} = a(T)$ using $c = c(t) = c(T)$:

$$c(T) = \frac{r}{1 - e^{-r(D-T)}} a(T) = \left(\frac{y(T)}{\xi(T)}\right)^{1/\gamma} \tag{81}$$

$$\implies \bar{a} = \frac{1 - e^{-r(D-T)}}{r} \left(\frac{y(T)}{\xi(T)}\right)^{1/\gamma} = (1 - e^{-r(D-T)})\bar{a}_\infty \tag{82}$$

There are three possible reasons why the wealth threshold declines with T:

- time to death $D - T$ decreases
- labor income $y(T)$ decreases
- disutility from work $\xi(T)$ increases

Relationship between total wealth and wealth threshold:

$$a(t) + h(t) = \frac{1 - e^{-r(D-t)}}{1 - e^{-r(D-T)}} \bar{a} = \left(1 - e^{-r(D-t)}\right) \bar{a}_\infty \tag{83}$$

Wealth threshold if $D \to \infty$:

$$a(t) + h(t) = \bar{a}_\infty = \frac{1}{r} \left(\frac{y(T)}{\xi(T)}\right)^{1/\gamma} \tag{84}$$

A solution for T only exists if wealth threshold is lower than total wealth $a(t) + h(t)$ as $T \to \infty$.

Explicit retirement age formula if $\dot{y} = 0$, $\dot{\xi} = 0$, and $D \to \infty$:

$$a(t) + \frac{1 - e^{-r(T-t)}}{r} y = (1 - e^{-r(D-t)})\bar{a}_\infty \tag{85}$$

$$\implies T - t = -\frac{1}{r} \log \left(\frac{r}{y} \left(a(t) + \frac{y}{r} - (1 - e^{-r(D-t)})\bar{a}_\infty\right)\right) \tag{86}$$

Effect of wealth shock on retirement age $dT/da(t)$ and final MPC formula

Differentiate (83) with respect to $a(t)$:

$$1 + \frac{dh}{dT} \frac{dT}{da(t)} = (1 - e^{-(D-t)}) \frac{d\bar{a}_\infty}{dT} \frac{dT}{da(t)} \tag{87}$$

Special case $D \to \infty$:

$$1 + \frac{dh}{dT}\frac{dT}{da(t)} = \frac{d\bar{a}}{dT}\frac{dT}{da(t)} \tag{88}$$

The equation above is illustrated in Figure 2.

Effect of wealth shock on retirement age $dT/da(t)$:

$$\frac{dT}{da(t)} = \left(-\frac{dh}{dT} + (1 - e^{-(D-t)})\frac{d\bar{a}_\infty}{dT}\right)^{-1} \tag{89}$$

$$= -\left(\frac{dh}{dT}\right)^{-1}\frac{1}{1+x(t)} \tag{90}$$

$$x(t) = \left(1 - e^{-r(D-t)}\right)\left(\frac{dh}{dT}\right)^{-1}\left(-\frac{d\bar{a}_\infty}{dT}\right) \tag{91}$$

Effect of retirement age on wealth threshold (both finite D and $D \to \infty$):

$$-\frac{d\bar{a}/dT}{\bar{a}} = \frac{1}{\gamma}\left(-\frac{\dot{y}(T)}{y(T)} + \frac{\dot{\xi}(T)}{\xi(T)}\right) + r\left(\frac{1}{1-e^{-r(D-T)}} - 1\right) \tag{92}$$

$$-\frac{d\bar{a}_\infty/dT}{\bar{a}_\infty} = \frac{1}{\gamma}\left(-\frac{\dot{y}(T)}{y(T)} + \frac{\dot{\xi}(T)}{\xi(T)}\right) \tag{93}$$

Effect of wealth shock on retirement age $dT/da(t)$

$$\frac{dT}{da(t)} = -\left(\frac{dh}{dT}\right)^{-1}\frac{1}{1+x(t)} \tag{94}$$

$$x(t) = \frac{1}{\gamma}e^{r(T-t)}\frac{1-e^{-r(D-t)}}{1-e^{-r(D-T)}}\left(-\frac{\dot{y}(T)}{y(T)} + \frac{\dot{\xi}(T)}{\xi(T)}\right)\frac{\bar{a}}{y(T)} \tag{95}$$

Plug (94) into (14) and (15):

$$MPC_w(t) = \frac{r}{1-e^{-r(D-t)}}\frac{x(t)}{1+x(t)} \tag{96}$$

$$MPC_r(t) = \frac{r}{1-e^{-r(D-t)}} \tag{97}$$

The results in equations (16)-(18) correspond to the special case $D \to \infty$ and $\dot{\xi} = 0$.

C Additional figures and tables

QSP12n [added August 2015]

Suppose next year you were to find your household with **10% more income** than you currently expect. What would you do with the extra income?

- ❍ Save or invest all of it (1)
- ❍ Spend or donate all of it (2)
- ❍ Use all of it to pay down debts (3)
- ❍ Spend some and save some (4)
- ❍ Spend some and use part of it to pay down debts (5)
- ❍ Save some and use part of it to pay down debts (6)
- ❍ Spend some, save some and use some to pay down debts (7)

Show QSP12a if codes 4,5,6, or 7 selected at QSP12n

QSP12a [added August 2015]

Please indicate what share of the extra income you would use to... (Please note that the three proportions need to add up to 100%)

Save or invest (1)	________________	% (1)
Spend or donate (2)	________________	% (2)
Pay down debts (3)	________________	% (3)

Figure 10: Survey questions in the SCE that elicit the marginal propensity to consume out of a windfall gain.

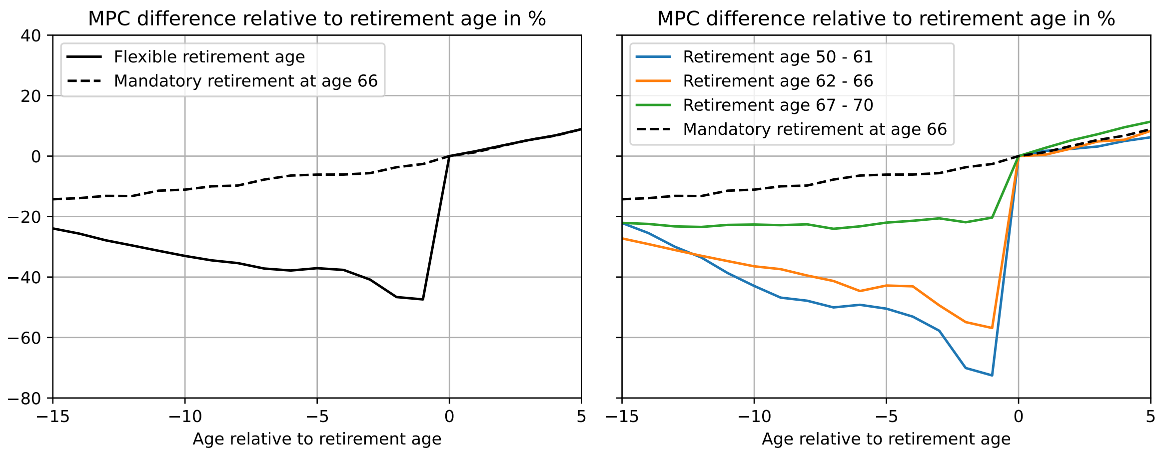

Figure 11: MPC difference relative to retirement age in %. See figure 6 for the percentage point difference.

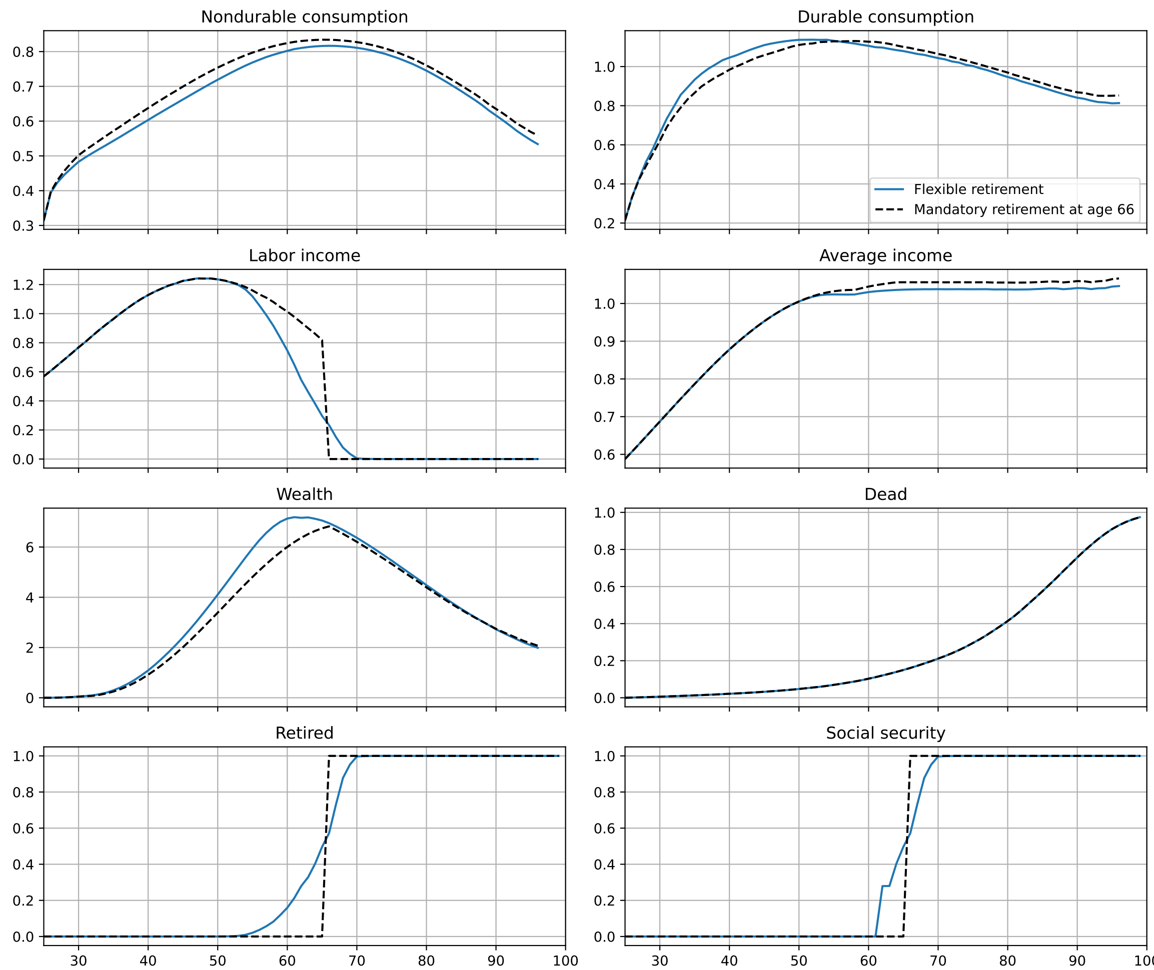

Figure 12: Average value of selected variables over the life-cycle.

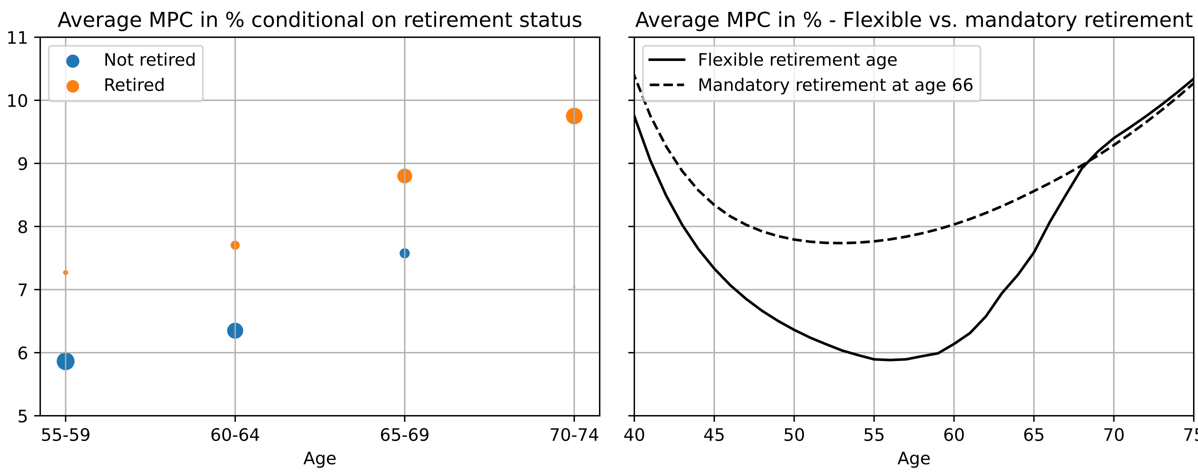

Figure 13: Simulated MPCs in the quantitative life-cycle model without durable goods $(1-\alpha=0)$. See Figure 5 for a comparison with the baseline model with durable goods. (i) Mean MPC conditional on age and retirement status. The size of the dots is proportional to the number of simulated agents in a certain group. (ii) Mean MPC conditional on age but not retirement status, both for the baseline version of the model (flexible retirement) and for a mandatory retirement age $T_n = 66$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Retired	5.84***	5.44***	4.13**	5.37***	4.34*	4.28*	4.67*
	(1.68)	(1.69)	(1.91)	(1.70)	(2.43)	(2.44)	(2.46)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓
Age, age^2	✓	✓	✓	✓	✓	✓	✓
Demographic characteristics		✓	✓	✓	✓	✓	✓
Income and financial wealth		✓	✓	✓	✓	✓	✓
Subjective health			✓				
Health expenditures				✓			
Probability to live to age 65					✓		
Probability to live to age 75						✓	
Probability to live to age 85							✓
Observations	1,963	1,810	1,578	1,810	1,026	1,022	1,010
Adjusted R^2	0.02	0.04	0.04	0.04	0.03	0.02	0.03

Note: *p<0.1; **p<0.05; ***p<0.01

Table 7: Results from a linear regression of the self-reported MPC (in %) on retirement status. This regression uses an alternative definition of the retirement dummy.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
One retired	1.39	1.14	0.62	1.05	3.15	3.06	3.14
	(2.13)	(2.15)	(2.34)	(2.16)	(3.07)	(3.09)	(3.10)
All retired	8.29***	7.91***	6.70***	7.78***	9.31***	9.26***	9.96***
	(1.98)	(2.01)	(2.21)	(2.02)	(3.41)	(3.42)	(3.47)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓
Age, age^2	✓	✓	✓	✓	✓	✓	✓
Demographic characteristics		✓	✓	✓	✓	✓	✓
Income and financial wealth		✓	✓	✓	✓	✓	✓
Subjective health			✓				
Health expenditures				✓			
Probability to live to age 65					✓		
Probability to live to age 75						✓	
Probability to live to age 85							✓
Observations	1,963	1,810	1,578	1,810	1,026	1,022	1,010
Adjusted R^2	0.03	0.05	0.04	0.05	0.03	0.03	0.04

Note: *p<0.1; **p<0.05; ***p<0.01

Table 8: Results from a linear regression of the self-reported MPC (in %) on retirement status. See regression equation (2).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
age_minus_65	0.09	0.00	0.07	0.03	-0.57	-0.52	-0.50
	(0.16)	(0.16)	(0.17)	(0.16)	(1.64)	(1.64)	(1.67)
age_minus_65_sq	-0.01	-0.02	-0.02	-0.02	-0.05	-0.05	-0.05
	(0.02)	(0.03)	(0.03)	(0.03)	(0.14)	(0.14)	(0.14)
health_2			4.45**				
			(2.16)				
health_3			3.37				
			(2.36)				
health_4			4.23				
			(2.89)				
health_exp_2				-1.30			
				(2.34)			
health_exp_3				-3.90*			
				(2.16)			
health_exp_4				-1.54			
				(2.37)			
high_educ		3.18**	3.38**	3.07**	4.60***	4.49***	4.66***
		(1.39)	(1.48)	(1.40)	(1.73)	(1.71)	(1.72)
income_Q2		-0.59	0.08	-0.42	-0.40	-0.56	-0.93
		(2.19)	(2.35)	(2.17)	(3.12)	(3.14)	(3.15)
income_Q3		-1.95	-3.69	-1.61	-4.81	-4.92	-5.00
		(2.46)	(2.55)	(2.47)	(3.10)	(3.13)	(3.13)
income_Q4		-4.49*	-4.64*	-4.15	-5.19	-5.38	-5.45
		(2.52)	(2.68)	(2.53)	(3.34)	(3.37)	(3.36)
male		2.23	0.87	2.06	2.71	2.65	2.22
		(1.55)	(1.69)	(1.56)	(2.05)	(2.12)	(2.16)
mort_65					-0.01		
					(0.05)		
mort_75						0.01	
						(0.04)	
mort_85							0.01
							(0.04)
partner		-4.93***	-3.78**	-4.75***	-5.00**	-4.86**	-4.60*
		(1.80)	(1.88)	(1.81)	(2.34)	(2.37)	(2.40)
retired_strict	6.17***	5.74***	4.53**	5.65***	6.27**	6.23**	6.70**
	(1.71)	(1.73)	(1.91)	(1.73)	(2.73)	(2.73)	(2.76)
wealth_Q2		2.43	1.12	2.34	2.71	2.58	2.31
		(2.08)	(2.22)	(2.08)	(2.93)	(2.92)	(2.94)
wealth_Q3		6.28***	7.25***	6.34***	4.76	4.55	4.39
		(2.35)	(2.60)	(2.36)	(3.07)	(3.10)	(3.09)
wealth_Q4		7.86***	7.74***	7.66***	4.02	3.88	3.63
		(2.49)	(2.73)	(2.48)	(3.17)	(3.19)	(3.19)
year_2015	21.55***	20.63***	18.17***	22.35***	19.36**	18.81***	19.27***
	(2.23)	(2.70)	(4.65)	(3.09)	(7.74)	(7.14)	(6.69)
year_2016	16.11***	14.38***	11.97***	16.29***	14.84**	14.10**	14.63**
	(1.89)	(2.51)	(3.11)	(2.95)	(7.08)	(6.43)	(5.99)
year_2017	16.63***	16.39***	13.59***	18.13***	15.56**	14.83**	15.12***
	(1.76)	(2.44)	(3.29)	(3.02)	(6.58)	(5.98)	(5.59)
year_2018	20.09***	19.25***	16.81***	21.14***	18.18***	17.62***	18.31***
	(1.91)	(2.51)	(3.30)	(2.95)	(6.80)	(6.28)	(5.91)
year_2019	17.68***	15.81***	13.55***	17.54***	15.93**	15.22**	15.02***
	(1.81)	(2.34)	(3.17)	(2.85)	(6.93)	(6.22)	(5.76)
Observations	1,963	1,810	1,578	1,810	1,026	1,022	1,010
R^2	0.02	0.05	0.05	0.05	0.05	0.04	0.05
Adjusted R^2	0.02	0.04	0.04	0.04	0.03	0.03	0.03

Note: *p<0.1; **p<0.05; ***p<0.01

Table 9: Results from a linear regression of the self-reported MPC (in %) on retirement status. Unabbreviated version of Table 1.

	(1)	(2)	(3)	(4)
age_minus_65	0.49	1.81	1.77	1.69
	(1.92)	(1.94)	(1.98)	(1.91)
age_minus_65_sq	0.08	0.19	0.17	0.17
	(0.17)	(0.17)	(0.18)	(0.17)
health_2			-7.93*	
			(4.11)	
health_3			-17.41***	
			(4.51)	
health_4			-30.93***	
			(4.89)	
health_exp_2				-7.87**
				(3.82)
health_exp_3				-6.36*
				(3.64)
health_exp_4				-8.21**
				(3.70)
high_educ		6.52***	4.75**	6.26***
		(2.27)	(2.38)	(2.30)
income_Q2		0.11	-0.63	1.13
		(4.06)	(4.44)	(4.12)
income_Q3		5.24	3.21	6.64
		(4.18)	(4.46)	(4.27)
income_Q4		5.55	1.93	6.28
		(4.29)	(4.48)	(4.37)
male		-11.39***	-9.20***	-11.38***
		(2.65)	(2.71)	(2.66)
partner		-3.33	-2.88	-2.92
		(3.03)	(3.27)	(3.02)
retired_strict	1.25	-0.18	-3.05	-0.15
	(3.29)	(3.43)	(3.51)	(3.48)
wealth_Q2		1.53	-0.29	0.99
		(3.82)	(4.01)	(3.83)
wealth_Q3		3.93	-2.34	3.86
		(3.96)	(4.20)	(3.99)
wealth_Q4		5.01	-1.20	4.90
		(4.36)	(4.82)	(4.42)
year_2015	43.64***	48.25***	60.95***	53.49***
	(5.58)	(6.22)	(9.37)	(6.52)
year_2016	49.32***	54.10***	71.53***	59.61***
	(5.60)	(5.98)	(7.39)	(6.14)
year_2017	45.07***	50.15***	70.01***	55.22***
	(5.20)	(5.87)	(7.31)	(6.06)
year_2018	49.40***	53.66***	74.46***	59.39***
	(5.36)	(6.31)	(7.85)	(6.50)
year_2019	47.59***	52.18***	71.02***	57.46***
	(5.31)	(5.89)	(7.20)	(6.03)
Observations	1,079	1,010	878	1,010
R^2	0.01	0.07	0.17	0.08
Adjusted R^2	0.00	0.06	0.15	0.06

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10: Results from linear regression with probability to live to 85 as dependent variable.

	(1)	(2)
Retired	1.20***	2.71***
	(0.01)	(0.02)
Age, age^2	✓	✓
Income quartiles		✓
Wealth quartiles		✓
Observations	1,693,342	1,693,342
Adjusted R^2	0.14	0.30
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 11: Results from a linear regression of the simulated MPCs (in %) on retirement status. The simulated MPCs are generated in a model without durable goods ($\alpha = 1$). See Table 1 for a comparison with the empirical MPCs and Table 5 for a comparison with the baseline model with durable goods.