PRELIMINARY/DO NOT CITE

Patterns of Consumption and Savings around Retirement

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Keywords: retirement, spending, savings, consumer debt

JEL codes: G51, D12, D14, E21, J26, J32

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This chapter reviews the economic literature looking at how consumption, savings, and other positions on household balance sheets change around retirement. Four patterns stand out. First, many households have barely any savings and hold substantial amounts of consumer debt at the time of retirement. Second, consumption falls at retirement, possibly due to work-related expenses or because households face unexpected adverse shocks. Third, liquid savings increase at retirement. Fourth, wealth increases more over the course of retirement for the average household. We discuss why and how analyzing these patterns helps us to answer the ultimate question of whether or not households save enough for retirement.

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1 Introduction

In many developed countries, mandatory retirement contribution plans are becoming less common and voluntary savings schemes have gained importance shifting the responsibility of preparing for retirement onto individuals. This makes sound personal finances at the onset of retirement more important than ever. But many people have barely any savings and hold substantial amounts of consumer debt at the time of retirement (Skinner, 2007; Anguelov and Tamborini, 2009; Poterba et al., 2012). Properly understanding what happens to household spending and balance sheets around retirement is informative about the question whether people plan properly and save enough for retirement.

There exists a large literature on two "retirement puzzles:" (1) the empirical observations that spending drops upon retirement, i.e., the "retirement-consumption" puzzle, and (2) the observation that wealth rises after retirement, i.e., the "retirement-savings" puzzle.

The retirement-consumption puzzle considers a central implication of standard life-cycle models of household consumption and savings: that the marginal utility of consumption should be smoothed across periods of predictably high and low income. However, a number of empirical studies (e.g., Banks et al., 1998; Bernheim et al., 2001; Schwerdt, 2005; Haider and Stephens, 2007; Fe, 2019) find a sharp decline in consumption during the first years of retirement.[1] The leading explanation for this puzzle is provided by Aguiar and Hurst (2005, 2013) and Hurst (2008); they argue that spending, rather than consumption, decreases on the grounds that individuals reduce their work-related expenses and overall spending through household production.[2]

The retirement-savings puzzle considers the prediction of the standard life cycle model that individuals should decumulate assets over the course of retirement. Recent literature documents that mean and median cohort wealth, for either singles or couples, remains constant or rises for many years after retirement (Love et al., 2009; Poterba et al., 2011a,b; Kieren and Weber, 2019).[3] The leading explanations for this puzzle are longevity and medical expense risks, as theorized by DeNardi et al. (2010) and Laitner et al. (2018), and empirically analyzed by Jones et al. (2018) and Ameriks et al. (2016).

[1] Following Davies (1981) and Hamermesh (1984), Banks et al. (1998) document a decline in consumption at retirement using a pseudo panel from the Family Expenditure Survey (FES) in the UK. Bernheim et al. (2001) confirm this finding using longitudinal data from the Panel Study of Income Dynamics (PSID). The drop in consumption at retirement is theoretically rationalized by Laitner and Silverman (2005), Pagel (2017), and Huang and Caliendo (2011), among others. Moreover, Ameriks et al. (2007) and Haider and Stephens (2007) provide evidence that the drop is expected. Guo et al. (2022) shows that households' consumption drops farther if they are less prepared for retirement, as measured by their pension and amortized assets at retirement relative to their pre-retirement income.

[2] While some additional studies provide evidence supporting this explanation (see, e.g., Hurd and Rohwedder, 2003; Battistin et al., 2009), others argue against it (such as Stephens Jr and Toohey, 2018).

[3] Love et al. (2009) construct a measure of wealth beginning at age 65 and document that it rises with age. Poterba et al. (2011a,b) show that individuals do not withdraw more funds from their personal retirement accounts relative to their rate of return, which causes wealth to effectively rise during retirement. Guo et al. (2020) shows however that individuals tend to claim social security benefits early.

A few other studies look at how other positions on households' balance sheets are affected by retirement. First, Addoum (2016) shows that household portfolios become less risky when men retire using PSID data. Second, Agarwal et al. (2009) documents that financial mistakes, such as suboptimal use of credit card balance transfer offers, follow a U-shaped pattern over the life cycle, i.e., financial mistakes are increasing for older adults. Third, Agarwal et al. (2015) show that credit card spending declines while debit card spending increases upon retirement, which may be indicative of a change in consumer debt. Fourth, Carlin et al. (2019) discuss generational differences in managing personal finances.

In this short paper, we use transaction-level data from a personal financial management software in Iceland to investigate how individuals' liquid savings and consumer debt positions change in the 10-year window around retirement. We show that individuals are 4 percent more likely to have liquid savings and save 28 percent more, as measured by interest income, after they retire. Additionally, individuals are 4 percent less likely to overdraw their checking accounts post-retirement. Such overdrafts are the predominant way of rolling over high-interest unsecured consumer debt in Iceland. New retirees also reduce their amounts of overdraft debt, as measured by interest payments, by 55 percent. We document these effects in several different specifications, from simple individual-level mean comparisons before versus after retirement to event study designs controlling for individual and month-by-year fixed effects as well as income.

If individuals expect that income decreases upon retirement, they should save more in anticipation of the decline in income rather than after. In Iceland, individuals face a sizable step down in income at the time of retirement. But the Icelandic pension system is both transparent and comprehensive: individuals can easily look up how much their annuitized pension income will be and there is no longevity risk to income, as it is indexed to the consumer price level.

People may compensate for lower retirement income by liquidating voluntary retirement accounts, investment accounts, or other illiquid assets, such as real estate, which would explain our findings. However, because we observe all pension liquidations as well as liquidations from investment accounts and any other uncategorized inflows (from real estate transactions for instance), we can show that liquidations are unaffected or decreasing around retirement for the average individual.

Instead, spending drops by more than income upon retirement, which is why we see an increase in liquid savings and a decrease in consumer debt. Potential reasons are drops in work-related expenses, increases in home production, or decreases in the opportunity costs of time. But if people know in advance that they can save more by retiring, they should retire as early as possible — unless the additional pension benefit from working longer exceeds the additional money they save by retiring. After age 67, the additional benefits in pension payments from working for one more month are small: approximately 0.5 percent or 10 USD per month in additional pension income. These increases in pension income are much smaller than the average savings from retiring for our sample, which equal monthly reductions in overdrafts of approximately 102 USD and monthly increases in liquid savings balances of approximately 210 USD.

Therefore, individuals should retire as early as possible as they can save more by doing so. However, we find that individuals continue to work for many months and sometimes years beyond reaching the retirement eligibility age. We conclude that our findings cannot be fully explained by work-related expenses or any other theory that reduces consumption needs around retirement but require a reason for why individuals still wait to retire.

Another potential explanation for our findings is that health shocks cause individuals to simultaneously retire and increase their needs for precautionary savings. For three reasons, however, we argue that health shocks and increased medical expense risks cannot fully explain our findings. First, Iceland is a Nordic welfare state. As mentioned, the pension income is not subject to income risks due to either longevity or price. Moreover, the health care system is comprehensive, and individuals do not face large medical expense risks of the type that many US households face. Out-of-pocket expenses, even for small items such as copays for medical supplies, are capped. Second, we do not observe increases in pharmacy spending at retirement (and pharmacy expenditures are very small shares of individuals' budgets). Because copayments are mandatory in Iceland up to the cap, pharmacy spending is a proxy for health status. Thus, we argue that the average individual does not seem to retire because of health shocks and such shocks would not simultaneously increase medical expenditure risks.[4] Third, if individuals rationally expect an increase in medical expenses after retirement, then they should save more before retirement rather than only after.

To explain our findings, two ingredients are necessary: first, it must be explained why consumption falls at retirement (e.g., due to work-related expenses); second, it must be explained why people keep working even though they can save more by retiring (e.g., because people did not expect work-related expenses to fall as much or they underestimated the medical expense risk they face after retirement, (as in Heimer et al., 2019)). Additionally, we discuss several other potential explanations; for instance, reductions in consumer debt may be driven by decreases in borrowing capacity that we can observe through credit limits. However, we do not find that individual borrowing capacity or liquidity decreases around retirement. Furthermore, we discuss labor-leisure substitution, intra-household bargaining, consumption insurance, lump-sum pension payments, and inventory savings. We conclude, however, that these theories all have difficulty explaining our findings.

We then turn to limited-rationality approaches and consider two classes of models: non-standard planning behavior and non-standard preferences. Even with a limited planning hori-

[4] The Icelandic health care system is financed by taxes, which is common in the Nordic welfare state model and implies that the population has equal access to the health care and welfare system. Iceland does not operate its health care system based on financial need, but some disadvantaged groups, including disabled and elderly individuals, generally receive discounts on personal health expenses. Out-of-pocket payments are a source of funding for the universal health care system and amount to 9 percent of GDP. In comparison, in the US, out-of-pocket medical expenditures amount to 17.7 percent of GDP. Furthermore, in Iceland, there is no risk of personal costs for large health expenses because they are capped. See https://en.wikipedia.org/wiki/Healthcare_in_Iceland.

zon, agents would begin to smooth consumption once they are close to retirement. We thus need an additional change in information processing or planning behavior at the time of retirement. To model where that is coming from, we turn to non-standard preferences. We first consider the most widely-applied model with a time-inconsistent overconsumption problem due to hyperbolic discounting (as in Laibson et al., 1998). This model does not predict a fall in consumption and an increase in savings upon retirement per se. However, if we assume that the agent corrects his or her time-inconsistency problem and stops overconsuming after retirement, then the model succeeds in explaining our joint findings. This assumed change in the agent's discount factor could be brought about by a change in information-processing capacity, more ability to plan, or any other change to his or her limited rationality (Bordalo et al., 2013, 2017; Koszegi and Szeidl, 2013; Bushong et al., 2015; Heimer et al., 2019; Malmendier and Shen, 2018; Lusardi and Mitchell, 2011; Fulford and Schuh, 2017).[5] We also show that a change in the agent's time-inconsistency problem rather than just a change in his or her patience is essential in generating an increase in savings after retiring. Such a correction of time-inconsistent overconsumption is present in a life-cycle model with expectations-based loss aversion, as developed by Kőszegi and Rabin (2009) followed by Pagel (2017). We can rationalize a simultaneous decrease in consumption and increase in savings upon retirement in a realistically calibrated, life-cycle model with two of the most widely applied non-standard preference specifications in the literature.

Our analysis is based on Icelandic data due to their unusually high quality. However, we show that we obtain similar findings using data from other sources: survey data from the US and bank account data from Germany. We first look at the most used US consumption survey data sets, the Consumer Expenditure Survey (CEX) and the Survey of Consumer Finances (SCF). We control for cohort, age, and year effects, although one must keep in mind that these results suffer from selection bias and measurement error. In the CEX data, we find that retirement results in an increase in savings (measured as income minus spending), checking account balances, and savings account balances. In the SCF data, we find that retirement results in reductions in leverage and debt and in increases in checking, savings, and call account balances. We also replicate our results in another set of individual- and transaction-level bank account data from Germany employing fixed-effects regressions. Finally, we use two more US survey data sets to replicate our results: the University of Michigan's Panel Study of Income Dynamics (PSID) and the Health and Retirement Study (HRS). Because these surveys poll the same households several times, we can also include household fixed effects in our regressions. In all these data sets, we find that consumption and debt holdings decrease upon the onset of retirement, but savings and checking account balances increase as do other measures of wealth.

The remainder of this paper proceeds as follows. Section 3 briefly reviews the Icelandic pension system, describes our data, and reports summary statistics. Section 4 presents our

[5] To this point, Carlin et al. (2017) show that individuals reduce their payments of non-sufficient funds fees after a reduction in the costs of monitoring their finances.

empirical approach and findings. Section 5 discusses how our findings can be theoretically rationalized. Finally, Section 6 offers some concluding remarks.

2 Background and the Icelandic Pension System

The Icelandic pension system consists of three pillars: a tax-financed public pension (i.e., social security benefits), compulsory occupational pension funds (i.e., defined benefit/contribution plans), which are the dominant feature of the system, and voluntary private pensions with tax incentives (i.e., tax-deductible savings). The age thresholds at which individuals are no longer punished for retiring early are the following. The public pension, which is need-based, is paid from age 67 on. Private pension savings can be withdrawn from age 60 on.

The occupational pension system is very transparent, and individuals can easily acquire all the necessary information about their annuitized and indexed retirement income using an online pension calculator. Furthermore, the Icelandic pension is paid as a monthly annuity and indexed to the consumer price level.

The occupational pension is paid from age 67 on, but it is possible to start withdrawing it as early as 65 with a reduced benefit, or as late as 70 with additional benefits. The system is designed so that an individual with the average life expectancy should be (actuarially) indifferent between working longer and retiring between the ages of 67 and 72. Thus the additional benefits paid out from working longer at age 67 equal the forgone pension payment at age 67. Using the current price levels, the monthly payment is approximately 2,525 USD if one retires at the age of 67 while it is 3,112 USD if one retires at the age of 72. The total payments forgone between the ages of 67 and 72 are 1,51,500 USD (2,525 per month for 5 years). It thus takes about 22 years of receiving the higher rate (3,112 USD) to make it worth forgoing those first five years of the lower rate, i.e., individuals would have to reach the age of 94.

This means that, after age 67, the additional benefit in pension payments from working for one more month are very small and approximately 10 USD (which equals (3,112-2,525)/(5*12)) or around 0.5 percent of the monthly pension income.

The exact calculations and also the printouts of the Icelandic pension calculator are provided in Appendix E.[6] Appendix E contains a more detailed review of the key features of the pension system in Iceland.

[6] See also http://www.oecd.org/els/public-pensions/PAG2017-country-profile-Iceland.pdf, https://www.tr.is/en/65-years, and https://www.tr.is/reiknivel/ for the pension calculator.

3 Data and Summary Statistics

3.1 Data

Our analysis is based on data generated by Meniga, a financial aggregation software provider in Iceland. Meniga's account-aggregation platform lets users view all of their accounts and credit cards from multiple banks. We have a comprehensive picture of individuals' financial lives as consumers in Iceland use electronic means of payments almost exclusively.

We study a subsample of 12,143 individuals with complete records, i.e., they have passed an "activity test" that is designed to verify that we are capturing all of their relevant financial information and described in Appendix B. We have data on spending by category, income by source, overdraft interest, and bank fees from 2011 to 2017 and data on balances and limits from 2014 to 2017. We perform the analysis on user-level data aggregated to the monthly level. Expenditure and income categories are very accurate and comprehensive. For instance, in the domain of restaurant spending, we observe very fine categories, such as "bakeries," and can distinguish individual trips from all daily spending.

We generally call income all incoming transactions or inflows. Thus, when retirees receive their annuitized pension payments, such income is effectively dissaving their pension assets. That said, we call it pension income and then look at liquid savings in bank accounts rather than considering the dissaving in pension assets. Furthermore, when individuals sell investment assets, we observe investment income, and other sale transactions are contained in an unclassified incoming transaction category or "other income."

All financial accounts are personal in Iceland but household members can link their accounts in the app so we can also look at total household income for our robustness checks.

In our data, individuals older than 60 are labeled as retired if all of the following three conditions hold (1) we see them receiving at least 1,000,000 ISK (approximately 10,000 USD) in pension payments over the sample period, (2) the pension payment in the current month is at least 30,000 ISK (approximately 300 USD), and (3) monthly pension payments in the following three months or the last three months amount to at least 30,000 ISK. As an alternative measure, we can only label individuals as retired if these three conditions hold and (4) we do not see a labor income payment higher than 150,000 ISK (1,466 USD) in the current month or the three months before and after. Both retirement definitions are associated with a step down in total income. The two retirement definitions are interesting in our context because some individuals in Iceland continue to work part-time after first claiming their annuitized pension payments. We thus have a first step down in income and then another step down for this subset of individuals. Our results are qualitatively and quantitatively similar for both measures.

Figure 1 displays the share of retired individuals at each age. Our inferred time of retirement is consistent with information from the OECD on the effective retirement age in Iceland as shown in Figure B.2.

The amount of savings and overdrafts that individuals hold can be inferred from information on balances, interest income from savings accounts, and interest paid on overdrafts. An overdraft occurs when withdrawals from a checking account exceed its available balance. This means that the balance is negative and the bank is providing credit to the account holder, with interest being charged at the agreed-upon rate. Virtually all checking accounts in Iceland offer a pre-agreed upon overdraft facility, the limit of which is based on individual credit scores and histories. In Iceland, individuals rarely roll over credit card debt. Instead they repay their credit cards in full each month (in fact, the automatic payment is mandated for the vast majority of credit cards) and then roll over overdraft debt instead.

Figure 1 also shows the life-cycle profiles of indicators and amounts of overdraft interest payments and interest earnings from savings accounts. Consumer debt decreases and interest earnings increase around the time of retirement.

3.2 Summary Statistics

In Olafsson and Pagel (2018a), we discuss in detail the spending, income, and demographic summary statistics of our user population and how they compare to those of the representative consumer survey of Statistics Iceland. Overall, our sample of individuals is similar to the overall population. This is reassuring as, when using app data, there is a concern that the user population is very young, well-situated, male, and tech-savvy. In our case, however, the app is marketed to consumers through their online banking interface and used by 20% of the adult population.[7] Furthermore, even if individuals never use the software or app, the moment they sign up, we obtain their data.

Table 1 displays summary statistics for retired and non-retired individuals who are eligible for retirement, i.e., have reached age 60, and who we observe as retired at some point during our sample period. As discussed in Subsection 2, we consider two definitions of retirement, i.e., when we condition only on the presence of pension payments or when we condition on both the presence of pension payments and the absence of labor income. For both definitions of retirement, we can see in the raw data that, on average, retired individuals have lower incomes, are more likely to hold liquid savings and less likely to hold consumer debt, pay less interest on their overdrafts, and incur fewer late fees. For the second definition of retirement, we also see a pronounced decrease in spending in the simple comparison of means in the raw data. Note that spending reflects discretionary categories only and excludes recurring expenses such as rent and bill payments. For the first definition of retirement, which conditions only on the presence of retirement income but not the absence of labor income, there is no drop in spending at retirement in the raw data mean averages. But this cross-sectional mean comparison can be affected by outliers, time trends, and selection, which our regression specifications will take

[7] According to Eurostat, 94 percent of Icelanders used internet banking in 2018. Source: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_bde15cbc&lang=en

care of with month-by-year and individual fixed effects.

4 Analyses and results

4.1 The Effects of Retirement on Personal Finances and Expenditures

To examine the effects of retirement on personal finances and spending we run the following regression:

$$\log(C_{it}) = \beta Retired_{it} + \phi_t + \eta_i + \gamma\Theta_{it} + \epsilon_{it} \tag{1}$$

where ϕ_t is a time, i.e., month-by-year, fixed effect and η_i is an individual fixed effect. Controlling for individual fixed effects allows us to compare individuals to themselves before and after retirement. $Retired_{it}$ is an indicator equal to 1 if individual i is retired at time t, and hence, the β coefficient measures the within-individual conditional mean effect of retirement. As the outcome variable, C_{it}, we look at consumer debt, liquid savings, and spending. We also provide results for additional specifications in which we include other control variables Θ_{it} of individual i at time t, for instance, log income $\log(Y_{it})$.

Clearly, retirement status is endogenous. Individuals may be induced to retire by the pension benefits thresholds discussed in Section 2. But as Figure 1 shows, there are no discontinuities in the fraction of individuals retiring at the retirement age thresholds of 60, 65, 67, and 70. Furthermore, between the ages of 67 and 72, it is only beneficial to work longer if individuals expect to live until the age of 94. We thus cannot argue that the retirement coefficient β has a causal interpretation. In Section 5, we will then discuss which omitted variables can serve as an explanation for our findings by driving the decision to retire and the effects of retirement on consumer debt, liquid savings, and spending.

4.2 Results for Overdrafts, Liquid Savings, Bank Fees, and Credit Lines

We now investigate the effects of retirement on personal finances, in particular, whether individuals hold overdrafts and liquid savings as well as their credit limits and bank fees. Table 2 displays the estimated effects of retirement on personal finances based on the individual fixed-effects model, Equation (1), with and without controlling for total individual income for both definitions of retirement.

Individuals reduce their consumer debt considerably. When we look at consumer debt by interest expenses, we find a 55 percent reduction (56 percent after controlling for income).[8] Furthermore, the likelihood to borrow, as measured by the indicator for holding an overdraft at any point in a given month, also decreases by 4.4 percent (4.5 percent after controlling for

[8] Our estimates are not qualitatively or quantitatively affected by running the regressions in levels, winsorizing to address outliers, or taking the log of the ISK variables instead of the sine transformation.

income). The baseline probability is 46 percent (Table 1) which thus amounts to an approximately 10 percent decrease. Additionally, we find that both the likelihood of receiving interest income in a given month as well as the amount of interest income increases after retirement. The increase in the likelihood equals 3.6 percent on a baseline probability is 32 percent (Table 1), which thus amounts to an approximately 10 percent increase, and the increase in interest income payments is 28 percent. Additionally, individuals reduce their late fee payments but their credit capacity does not change.

The initial positions in overdraft debt and liquid savings are large. In Table 1, we can see that the average overdraft interest per month equals 24 USD which implies that, at the 13 percent annualized interest over our sample period, the overdraft balance is 24*12/0.13 = 2,215 USD on average.[9] The average interest income is 45 USD which implies that, at 6 percent annualized interest, the savings account balance is 9,000 USD on average. A 55 percent reduction in overdrafts and a 28 percent increase in savings equal monthly repayment of overdrafts in the neighborhood of 0.55*2,215/12 = 102 USD and increases in savings balances of approximately 210 USD per month. Individuals thus save much more than the additional 10 USD per month or 7 percent of extra pension income per year that they would receive more from working longer (pension payments equal 1,899 USD on average as displayed in Table 1). Because consumption falls by more than income, for whatever reason, individuals should retire as soon as possible.

Table 2 also shows the coefficients for three dummies: whether an individual is retired for less than 12 months, between 12 and 24 months, and more than 24 months. We can thus look at the dynamics of the reduction in overdraft interest expenses and interest earnings. For overdrafts, we can see that all three dummies are large and significant in the neighborhood of 50 percent reductions in overdraft expenses and 5 percent for the likelihood of overdrawing the checking account. Again, we do not find an effect on borrowing capacity as measured by available credit. The effect on the amount of interest income individuals receive depends on the definition of retirement. When individuals retire for good, it takes a year for the effect to manifest, when individuals receive retirement income but may or may not work part time the effect is larger in the first two years.

As additional robustness checks in Table 3, we add individual, month-and-year, and month-by-year fixed effects subsequently and show that our coefficients are robust to different fixed effects regimes. Here, we want to emphasize the coefficient when we control only for individual fixed effects. This is a simple conditional mean within-individual comparison of overdraft debt levels before and after retirement. As can be again clearly seen, the average individual decreases his or her overdraft debt after retirement and increases his or her liquid savings.

We find similar results whether or not we control for total individual income. Controlling for all income is important for the interpretation of our results. After all, it could be that individuals simply liquidate assets after entering retirement to repay their consumer debt. We

[9] See Figure C.3 for the interest rates over the sample period.

can measure and control for income at the household level, because individuals can link family members within the app and we observe these links. Controlling for household instead of individual income does not affect our results materially as we show in Table 3. Additionally, we show in Table A.1 that no other sources of income, e.g., from liquidiations of assets of real estate transactions, increase after retirement.

As we showed, our results are the same when we employ a stricter definition of retirement that not only conditions on the presence of pension payments but also the absence of labor income. Both retirement definitions are associated with a step down in total income. If we condition only on the presence of pension income, the fall in income equals approximately 8 percent. If we also condition on the absence of labor income, then we estimate a drop in income of approximately 22 percent, which is in line with estimates from the US, reported in Ameriks and Zeldes (2004) among others.

We thus observe robustly across a number of specifications that households not only delever but also increase their liquid savings. We will discuss in detail how to interpret our findings in Section 5. But first, we will briefly discuss the estimation results when we look at spending as the outcome variable.

4.3 Results for Spending by Category

Table A.2 shows the estimated effect of retirement on spending based on the individual fixed-effects model, Equation (1), with and without controlling for total income. These results show that spending drops upon retirement by 21.6 percent (26.8 percent when we control for income). The drops in spending in certain categories, such as groceries, may well be attributed to more efficient shopping and home production, as individuals have more time at their disposal after retirement. However, leisure-related expenses (for instance, sports and activities) also decrease substantially, suggesting that individuals are correcting an overconsumption problem. Other spending that can hardly be attributed to work, such as alcohol bought in stores and pharmacy spending, also falls upon retirement. We find the same to be true when turning to a finer categorization of food (Table A.3). Analyzing spending on food in more detail than previous studies is important because food expenses have received the most attention in the retirement consumption literature (for instance, Aguiar and Hurst, 2005, among many others).

Our results suggest that the drop in expenditures upon retirement are not fully explained by work-related expenses. After all, we also observe a drop in expenditures that is difficult to argue is work related, e.g., fine dining. Analyzing these spending patterns, however, does not paint a fully conclusive picture of whether the retirement puzzles are really puzzling. For instance, fine dining could be a work-related expense as well. We argue that we learn more from our results on personal finances about the relevance of the retirement-consumption puzzle and work-related expenses as its leading explanations.

4.4 Replicating the Analysis in Other Data Sets

We can replicate our results in the most commonly used survey data sets from the US: the CEX and SCF. However, the CEX and the SCF suffer from selection bias and measurement error due to their survey design and non-longitudinal structure.[10] To further bolster the credibility of our findings, we thus replicate our analysis using survey data sets from the US in which we can run individual fixed effects regressions (the PSID and HRS) and consider another transaction-level data set from Germany. We document the same findings in all datasets and we conclude that our results are not specific to Iceland. Additional detail can be found in Appendix D and Tables D.6 to D.10.

5 Potential Theoretical Explanations

We discussed in the introduction how our findings are not consistent with the two leading explanations for the retirement-consumption and retirement-savings puzzles. If work-related expenses are larger than the difference between pension and labor income, then individuals should retire early unless the additional monthly pension benefits for an additional month of work exceed the savings from retiring. But at the time that our individuals retire, the additional pension benefit from one month of work are much smaller than the reductions in overdrafts and increases in liquid savings we observe. This argument is illustrated in Figure A.1 and we thus need a reason for why individuals keep working. As discussed, if instead we want to explain our results with health shocks or medical expenses then individuals must revise their beliefs about their health downwards in a systematic way.

We provide a more detailed discussion of work-related expenses, health shocks, and medical expense risk in Subsection C.1 and also consider other potential explanations. In particular, we discuss wealth shocks, liquidation of assets, and returns of savings versus borrowing, credit constraints, consumption insurance, inventory considerations, or lump-sum pension withdrawals.

In this Subsection, we now discuss explanations that have a limited rationality or behavioral component as alternatives. Even with a limited planning horizon as in the models by Gabaix (2016), Huang and Caliendo (2011), and Caliendo and Aadland (2007), agents would begin to smooth consumption once they are close to retirement. We thus need an additional change in information processing or planning behavior at the time of retirement. To model where that is coming from, we turn to non-standard preferences.

There is widespread evidence for individuals having overconsumption problems (refer to **?**, for a literature survey). The most highly-cited and widely-applied models of overconsumption are based on quasi-hyperbolic discounting preferences, as in Laibson et al. (1998) and Laibson

[10] Existing literature has documented problems with survey-based measures of consumption (see e.g., Pistaferri, 2015).

et al. (2007). Furthermore, the preferences in Kőszegi and Rabin (2006, 2007, 2009) feature a time inconsistency and are the most cited models of beliefs-based preferences (Olafsson and Pagel, 2018b), which makes it worthwhile to see how far their predictive power extends to this "out-of-sample" test.

We first consider the most widely-applied model with a time-inconsistent overconsumption problem due to hyperbolic discounting (as in Laibson et al., 1998). This model does not predict a fall in consumption and an increase in savings upon retirement per se. However, if we assume that the agent corrects his or her time-inconsistency problem and stops overconsuming after retirement, then the model succeeds in explaining our joint findings.

The same correction of time-inconsistent overconsumption is present in a life-cycle model with expectations-based loss aversion, as developed by Kőszegi and Rabin (2009) followed by Pagel (2017). This model predicts that individuals will correct their overconsumption problem upon retiring because of the decrease in income uncertainty. When income is uncertain, as it is prior to retirement, individuals overconsume in the present and hope for a better realization of income in the future. But when income is certain, as it is after retirement, overspending results in a sure reduction in future spending. Because the agent dislikes this sure loss, he or she corrects her overconsumption problem after retirement as he or she starts consuming like a time-consistent agent.

In Appendix C.2.1 we solve a full-fledged, life-cycle model and show that our non-standard preferences generate a simultaneous drop in consumption at retirement and an increase in savings by running our empirical specification in the simulated consumption data (Table A.4). We thus rationalize a simultaneous decrease in consumption and increase in savings upon retirement in a realistically calibrated, life-cycle model with two of the most widely applied non-standard preference specifications in the literature.

In Appendix C.2.1 we show that indeed the model must feature that the agent's degree of present bias changes at the time of retirement in order to generate the joint finding of falling income and consumption but increasing liquid savings (or decreasing borrowing). This assumed change in the agent's discount factor could be brought about by a change in information-processing capacity, more ability to plan, or any other change to his or her limited rationality (Malmendier and Shen, 2018; Lusardi and Mitchell, 2011; Fulford and Schuh, 2017; Haider and Stephens, 2007; Ameriks et al., 2007; Mullainathan et al., 2007; Carvalho et al., 2016).[11] As alternative explanation, we could think of models of salience, memory, focusing, or relative thinking (Bordalo et al., 2013, 2017; Koszegi and Szeidl, 2013; Bushong et al., 2015; Heimer et al., 2019). It could be that income and spending after retirement are more salient, memorable, focused, or easier to compare in relative terms, which would all imply a change in planning behavior around retirement. The insufficient planning models (Huang and Caliendo, 2011; Caliendo and Aadland, 2007; Gabaix, 2016; Reis, 2006; Campbell and Mankiw, 1989)

[11] Carlin et al. (2017) show that individuals reduce their consumer debt after a reduction in the costs of monitoring one's finances.

can be combined with an update in information or planning ability to generate an increase in savings on top of a drop in consumption at retirement.

6 Conclusion

The responsibility of retirement saving has shifted from employers to individuals in recent years. Understanding whether people are adequately prepared and save enough for retirement has therefore become of utmost importance. Using a large transaction-level data set from a financial aggregator on income, spending, account balances, and credit limits, we document a substantial increase in liquid savings and a substantial decrease in consumer debt around retirement. These findings are difficult to explain in a model based on rational planning. Whenever individuals expect a fall in income, even if spending falls as well or even if they expect large medical expenses after retirement, they should save more before the anticipated fall in income rather than after.

Our findings add to two existing empirical patterns in household consumption and savings that have caused a stir in the academic literature: that consumption drops at retirement but savings and wealth appear to increase after retirement. Researchers have singled out promising explanations for both of these empirical observations that are consistent with rational planning. First, consumption drops at retirement because of a reduction in work-related expenses. Second, savings increase after retirement because of longevity and medical expense risks.

Our setting provides several additional tests to evaluate the validity of work-related expenses and medical expense risks as explanations for the existing retirement puzzles. We argue, however, that they are not providing fully satisfactory explanations for our new findings. Instead, we argue that our findings are consistent with theories that predict a change in the effective discount factor at retirement.

References

Addoum, Jawad M, "Household portfolio choice and retirement," *Review of Economics and Statistics*, 2016, (0).

Agarwal, Sumit, Jessica Pan, and Wenlan Qian, "The Composition Effect of Consumption around Retirement: Evidence from Singapore," *American Economic Review Papers & Proceedings*, 2015, *105* (5), 426–431.

_ , John C Driscoll, Xavier Gabaix, and David Laibson, "The age of reason: Financial decisions over the life cycle and implications for regulation," *Brookings Papers on Economic Activity*, 2009, *2009* (2), 51–117.

Aguiar, Mark and Erik Hurst, "Consumption vs Expenditure," *Journal of Political Economy*, October 2005, *113* (5), 919–948.

_ and _ , "Deconstructing Life Cycle Expenditure," *Journal of Political Economy*, 2013, *121* (3), 437–492.

Ameriks, J. and S. Zeldes, "How do Household Portfolio Shares vary with Age?," *Working Paper Columbia Business School*, 2004.

Ameriks, John, Andrew Caplin, and John Leahy, "Retirement Consumption: Insights from a Survey," *The Review of Economics and Statistics*, May 2007, *89* (2), 265–274.

_ , Joseph Briggs, Andrew Caplin, Matthew D Shapiro, and Christopher Tonetti, "Late-in-life Risks and the Under-insurance Puzzle," 2016.

Angeletos, G. M., D. Laibson, A. Repetto, and S. Weinberg, "The Hyperbolic Consumption Model: Calibration, Simulation, and Empirical Evaluation," *Journal of Economic Perspectives*, 2001, *15* (3), 47.

Anguelov, Chris E and Christopher R Tamborini, "Retiring in Debt-Differences between the 1995 and 2004 Near-Retiree Cohorts," *Soc. Sec. Bull.*, 2009, *69*, 13.

Banks, James, Richard Blundell, and Sarah Tanner, "Is There a Retirement-Savings Puzzle?," *The American Economic Review*, 1998, *88* (4), 769–788.

Battistin, Erich, Agar Brugiavini, Enrico Rettore, and Guglielmo Weber, "The Retirement Consumption Puzzle: Evidence from a Regression Discontinuity Approach," *American Economic Review*, 2009, *99* (5), 2209–26.

Bernheim, B. Douglas, Jonathan Skinner, and Steven Weinberg, "What Accounts for the Variation in Retirement Wealth among U.S. Households?," *American Economic Review*, September 2001, *91* (4), 832–857.

Blau, David M, "Retirement and consumption in a life cycle model," *Journal of Labor Economics*, 2008, *26* (1), 35–71.

Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer, "Salience and consumer choice," *Journal of Political Economy*, 2013, *121* (5), 803–843.

_ , _ , and _ , "Memory, attention, and choice," Technical Report, National Bureau of Economic Research 2017.

Bound, John, Todd Stinebrickner, and Timothy Waidmann, "Health, economic resources and the work decisions of older men," *Journal of Econometrics*, 2010, *156* (1), 106–129.

Brown, Jeffrey R, Gopi Shah Goda, and Kathleen McGarry, "Heterogeneity in State-Dependent Utility: Evidence from Strategic Surveys," *Economic Inquiry*, 2016, *54* (2), 847–861.

Brumberg, Richard and Franco Modigliani, "Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data," in Kenneth Kurihara, ed., *Post-Keynesian Economics*, New Brunswick, NJ: Rutgers University Press, 1954, pp. 388–436.

Bucciol, A., "Measuring Self-Control Problems: A Structural Estimation," *Journal of the Eu-*

ropean Economic Association, 2012.

Bushong, Benjamin, Matthew Rabin, and Joshua Schwartzstein, “A model of relative thinking,” *Unpublished manuscript, Harvard University, Cambridge, MA*, 2015.

Caliendo, Frank and David Aadland, “Short-term planning and the life-cycle consumption puzzle,” *Journal of Economic Dynamics and Control*, 2007, *31* (4), 1392–1415.

Campbell, John Y and Luis M Viceira, *Strategic asset allocation: portfolio choice for long-term investors*, Oxford University Press, USA, 2002.

_ and N Gregory Mankiw, “Consumption, income, and interest rates: Reinterpreting the time series evidence,” *NBER macroeconomics annual*, 1989, *4*, 185–216.

Carlin, Bruce, Arna Olafsson, and Michaela Pagel, “Fintech adoption across generations: Financial fitness in the information age,” Technical Report, National Bureau of Economic Research 2017.

_ , _ , and _ , “Generational Differences in Managing Personal Finances,” in “AEA Papers and Proceedings,” Vol. 109 2019, pp. 54–59.

Carroll, C., “Theoretical Foundations of Buffer Stock Saving,” *Working Paper Johns Hopkins University*, 2001.

Carroll, C. D., “Buffer Stock Saving and the Life Cycle/Permanent Income Hypothesis,” *Quarterly Journal of Economics*, 1997, *CXII*, 1–56.

Carvalho, Leandro, Arna Olafsson, and Dan Silverman, “Misfortune and Mistake: The Financial Conditions and Decision-making Ability of High-cost Loan Borrowers,” September 2019, (24405).

Carvalho, Leandro S., Stephan Meier, and Stephanie W. Wang, “Poverty and Economic Decision-Making: Evidence from Changes in Financial Resources at Payday,” *American Economic Review*, February 2016, *106* (2), 260–84.

Davies, James B, “Uncertain lifetime, consumption, and dissaving in retirement,” *Journal of political Economy*, 1981, *89* (3), 561–577.

de Nicola, Francesca and Xavier Giné, “How Accurate are Recall Data? Evidence from Coastal India,” *Journal of Development Economics*, 2014, *106* (0), 52 – 65.

Deaton, A., “Saving and Liquidity Constraints,” *Econometrica*, 1991, *59*, 1221–1248.

DeNardi, Mariacristina, Eric French, and John Bailey Jones, “Why Do the Elderly Save? The Role of Medical Expenses,” *Journal of Political Economy*, 2010, *118*, 39–75.

Do, What Behavioral Economics Tries To, “Behavioral economics: Past, present, future,” *Advances in behavioral economics*, 2011, p. 1.

Fe, Eduardo, “What Can We Learn About the Average Treatment Effect of Retirement on Consumption?,” *Available at SSRN 3329588*, 2019.

Finkelstein, Amy, Erzo FP Luttmer, and Matthew J Notowidigdo, “What good is wealth without health? The effect of health on the marginal utility of consumption,” *Journal of the European Economic Association*, 2013, *11* (suppl_1), 221–258.

French, Eric, “The effects of health, wealth, and wages on labour supply and retirement behaviour,” *The Review of Economic Studies*, 2005, *72* (2), 395–427.

Fulford, Scott and Scott D Schuh, “Credit card utilization and consumption over the life cycle and business cycle,” *Consumer Financial Protection Bureau Office of Research Working Paper*, 2017, (2017-03).

Gabaix, Xavier, “Behavioral macroeconomics via sparse dynamic programming,” Technical Report, National Bureau of Economic Research 2016.

Ganong, Peter and Pascal Noel, “Consumer spending during unemployment: Positive and normative implications,” *American economic review*, 2019, *109* (7), 2383–2424.

Gourinchas, Pierre-Olivier and Jonathan A. Parker, “Consumption Over the Life Cycle,” *Econometrica*, January 2002, *70* (1), 47–89.

Gul, F. and W. Pesendorfer, "Self-Control and the Theory of Consumption," *Econometrica*, 2004, *72* (4), 119–158.

Guo, Rui, Wei Sun, Jianqiu Wang, and Gang Xiao, "Why do retired workers claim their social security benefits so early? A potential explanation based on the cumulative prospect theory," *Applied Economics*, 2020, *52* (5), 490–505.

Guo, Sheng, Jonathan Skinner, and Stephen Zeldes, "Inattentive Households and Consumption Declines During Retirement," *Working Paper*, 2022.

Haider, Steven J. and Melvin Stephens, "Is There a Retirement-Consumption Puzzle? Evidence Using Subjective Retirement Expectations," *The Review of Economics and Statistics*, May 2007, *89* (2), 247–264.

Hamermesh, Daniel S, "Life-cycle effects on consumption and retirement," *Journal of Labor Economics*, 1984, *2* (3), 353–370.

Han, Bing, David Hirshleifer, and Johan Walden, "Visibility bias in the transmission of consumption beliefs and undersaving," Technical Report, National Bureau of Economic Research 2019.

Harris, Ed and John Sebelhaus, "Consumer Expenditure Survey," *Congressional Budget Office*, 2000.

Heimer, Rawley Z, Kristian Ove R Myrseth, and Raphael S Schoenle, "YOLO: Mortality beliefs and household finance puzzles," *The Journal of Finance*, 2019, *74* (6), 2957–2996.

Huang, Kevin XD and Frank Caliendo, "Rationalizing multiple consumption-saving puzzles in a unified framework," *Frontiers of Economics in China*, 2011, *6* (3), 359.

Hundtofte, Sean, Arna Olafsson, and Michaela Pagel, "Credit smoothing," Technical Report, National Bureau of Economic Research 2019.

Hurd, Michael and Susann Rohwedder, "The Retirement-Consumption Puzzle: Anticipated and Actual Declines in Spending at Retirement," NBER Working Papers 9586, National Bureau of Economic Research, Inc March 2003.

Hurst, Erik, "Understanding Consumption in Retirement: Recent Developments," in John Ameriks and Olivia Mitchell, eds., *Recalibrating Retirement Spending and Saving*, Oxford University Press, September 2008, chapter Understanding Consumption in Retirement: Recent Developments.

Jones, John Bailey, Mariacristina De Nardi, Eric French, Rory McGee, and Justin Kirschner, "The lifetime medical spending of retirees," Technical Report, National Bureau of Economic Research 2018.

Jr, Melvin Stephens and Desmond Toohey, "Changes in Nutrient Intake at Retirement," 2018.

Karlan, Dean and Jonathan Zinman, "Lying about Borrowing," *Journal of the European Economic Association*, 2008, *6* (2/3), pp. 510–521.

Kieren, Pascal and Martin Weber, "When saving is not enough–The wealth decumulation decision in retirement," 2019.

Koszegi, B. and A. Szeidl, "A Model of Focusing in Economic Choice," *Quarterly Journal of Economics*, 2013, *128* (1), 53–104.

Kőszegi, Botond and Matthew Rabin, "A model of reference-dependent preferences," *The Quarterly Journal of Economics*, 2006, *121* (4), 1133–1165.

— **and** — , "Reference-dependent risk attitudes," *American Economic Review*, 2007, *97* (4), 1047–1073.

— **and** — , "Reference-Dependent Consumption Plans," *American Economic Review*, June 2009, *99* (3), 909–36.

Laibson, D., A. Repetto, and J. Tobacman, "Self-Control and Saving for Retirement," *Brook-*

ings Papers on Economic Activity, 1998, *1*, 91–196.

_ , _ , and _ , "Estimating Discount Functions with Consumption Choices over the Lifecycle," *American Economic Review*, 2012.

Laibson, David, Andrea Repetto, and Jeremy Tobacman, "Estimating discount functions with consumption choices over the lifecycle," Technical Report, National Bureau of Economic Research 2007.

Laitner, John and Dan Silverman, "Estimating life-cycle parameters from consumption behavior at retirement," Technical Report, National Bureau of Economic Research 2005.

_ , _ , and Dmitriy Stolyarov, "The Role of Annuitized Wealth in Post-Retirement Behavior," *American Economic Journal: Macroeconomics*, 2018, *10* (3), 71–117.

Li, Geng, Robert F Schoeni, Sheldon Danziger, and Kerwin Kofi Charles, "New Expenditure Data in the PSID: Comparisons with the CE," *Monthly Labor Review*, 2010, *133* (2), 29–39.

Love, David A., Michael G. Palumbo, and Paul A. Smith, "The trajectory of wealth in retirement," *Journal of Public Economics*, 2009, *93* (1), 191 – 208.

Lundberg, Shelly, Richard Startz, and Steven Stillman, "The Retirement-Consumption Puzzle: A Marital Bargaining Approach," *Journal of Public Economics*, 2003, *87* (5-6), 1199 – 1218.

Lusardi, Annamaria and Olivia S Mitchell, "Financial literacy and planning: Implications for retirement wellbeing," Technical Report, National Bureau of Economic Research 2011.

Malmendier, Ulrike and Leslie Sheng Shen, "Scarred consumption," Technical Report, National Bureau of Economic Research 2018.

Mullainathan, Sendhil, Bindu Ananth, and Dean Karlan, "Microentrepreneurs and Their Money: Three Anomalies," Technical Report, Working Paper, Financial Access Initiative 2007.

O'Donoghue, T. and M. Rabin, "Doing it Now or Later," *American Economic Review*, 1999, *89* (1), 103–124.

Olafsson, Arna and Michaela Pagel, "The Liquid Hand-to-Mouth: Evidence from a Personal Finance Management Software," *The Review of Financial Studies*, 2018.

_ and _ , "The Ostrich in Us: Selective Attention to Financial Accounts, Income, Spending, and Liquidity," Technical Report 2018.

_ and _ , "Borrowing in response to windfalls," Technical Report, Working Paper 2019.

_ and Tomas Thornquist, "Bargaining over risk: The impact of decision power on household portfolios," Technical Report 2018.

Pagel, Michaela, "Expectations-Based Reference-Dependent Life-Cycle Consumption," *Review of Economic Studies*, 2017.

Parker, Jonathan A and Nicholas S Souleles, "Reported Preference vs. Revealed Preference: Evidence from the propensity to spend tax rebates," 2017.

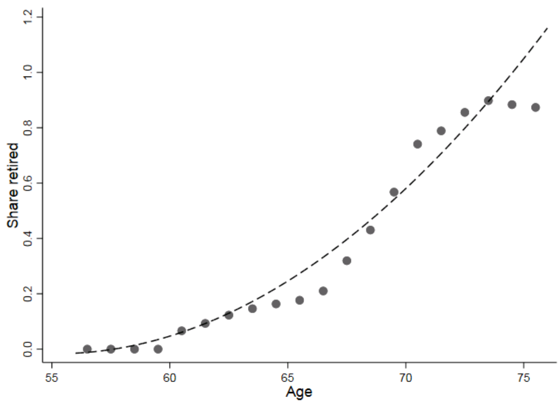
Pistaferri, Luigi, "Household Consumption: Research Questions, Measurement Issues, and Data Collection Strategies," *Journal of Economic and Social Measurement*, 2015, *40* (1-4), 123–149.

Poterba, James M, Steven F Venti, and David A Wise, "Were they prepared for retirement? Financial status at advanced ages in the HRS and AHEAD cohorts," Technical Report, National Bureau of Economic Research 2012.

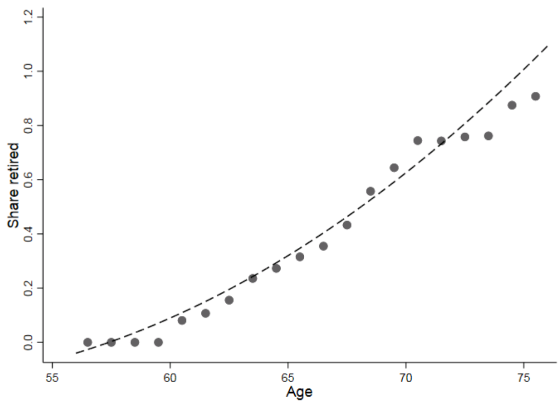
Poterba, James, Steven Venti, and David Wise, "The Composition and Draw-Down of Wealth in Retirement," *Journal of Economic Perspectives*, 2011, *25*, 95–117.

_ , _ , and _ , "Family Status Transitions, Latent Health, and the Post-Retirement Evolution of Assets," *In David A. Wise (ed.), Explorations in the Economics of Aging. Chicago: The*

University of Chicago Press, 2011.
Reis, Ricardo, "Inattentive consumers," *Journal of monetary Economics*, 2006, *53* (8), 1761–1800.
Schwerdt, Guido, "Why does consumption fall at retirement? Evidence from Germany," *Economics Letters*, 2005, *89* (3), 300 – 305.
Sims, Christopher A, "Implications of rational inattention," *Journal of monetary Economics*, 2003, *50* (3), 665–690.
Skinner, Jonathan, "Are you sure you're saving enough for retirement?," *Journal of Economic Perspectives*, 2007, *21* (3), 59–80.



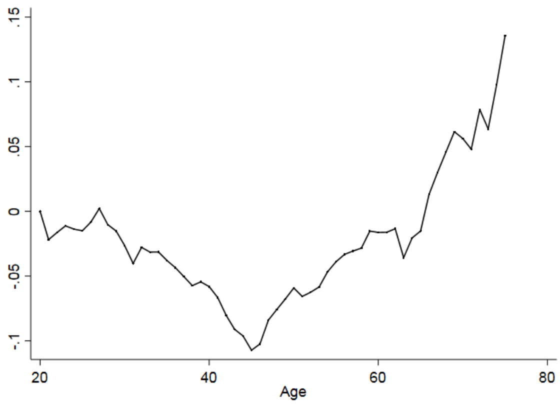
(A) Share of Retired Men by Age



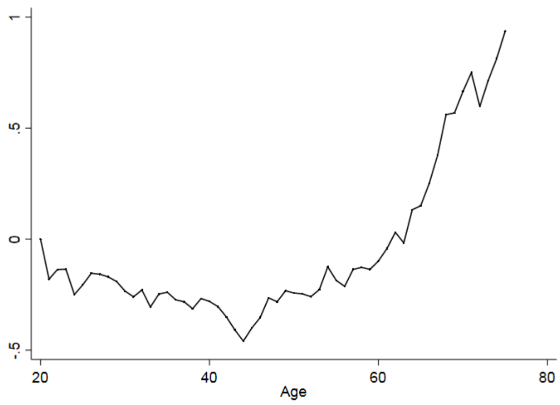
(B) Share of Retired Women by Age

(C) Indicator for Paying Overdraft Interest

(D) Overdraft Interest Expenses



(E) Indicator for Savings Account Interest



(F) Savings Account Interest

Figure 1: Share of Retired Individuals by Age

Notes: (A) and (B): Raw data using the inferred retirement date as described in Section 2. (C): Estimated coefficients from a regression of an indicator for overdraft interest expenses on a full set of age dummies, with age 20 being the omitted age dummy. The regressions include month-by-year and individual fixed effects. (D): Estimated coefficients from a regression of overdraft interest expenses on a full set of age dummies, with age 20 being the omitted age dummy. The regressions include month-by-year and individual fixed effects. Overdraft interest is measured in terms of its inverse hyperbolic sine to accommodate months when individuals do not have any overdraft interest expenses. (E): Estimated coefficients from a regression of an indicator for interest earnings from savings account deposits on a full set of age dummies, with age 20 being the omitted age dummy. The regressions include month-by-year fixed effects. (F): Estimated coefficients from a regression of interest earnings from savings account deposits on a full set of age dummies, with age 20 being the omitted age dummy. The regressions include month-by-year and individual fixed effects. Interest earnings are measured in terms of their inverse hyperbolic sine to accommodate months when individuals do not earn any interest from their bank deposits.

Table 1: Descriptive Statistics Before and After (Part-time) Retirement

	Eligible but not retired		Retired receiving pensions		Retired receiving pensions and low salary	
	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
Demographics:						
Age	65.9	3	69.7	5.2	71.4	5.6
Female	0.43	0.5	0.4	0.5	0.4	0.49
Monthly income:						
Labor income	4,497	5,610	2,276	4,862	818	3,681
Pensions	74	1,063	1,899	1,869	2,147	1,699
Personal finances:						
Overdraft indicator	0.46	0.5	0.38	0.49	0.31	0.46
# Overdrafts	0.52	0.65	0.46	0.67	0.36	0.59
Overdraft interest	24	66	17	56	11	48
Late fees	6	36	5	31	3.8	23.6
Interest income indicator	0.32	0.47	0.53	0.5	0.53	0.5
Interest income	45	724	79	609	472	6,113
Liquidity in days of average spending	180	152	201	330	400	527
Monthly spending:						
Total discretionary	1,809	1,987	1,887	2,480	1,706	1,958
Groceries	495	330	529	332	507	318
Fuel	291	270	230	222	201	207
Alcohol	94	156	96	169	87	158
Ready-made food	103	132	119	153	106	142
Home improvements	206	557	224	1,273	187	500
Home security	12	38	11	42	11	46
Vehicles	168	1,663	185	1,890	152	1,673
Clothing & accessories	96	186	97	191	83	167
Sports & activities	8	40	10	46	8	41
Pharmacies	70	88	80	94	78	94

Notes: All numbers are inflation adjusted and in US dollars. All income, spending, and interest statistics are at the individual-month level. We study a subsample 12,143 active users with complete records, i.e., for whom we observe all balances, labor income arrivals, and transactions. The "activity test" that is designed to verify that we are capturing all of their relevant financial information is described in Appendix B. Discretionary spending excludes recurring spending such as rents or utilities bills. Individuals older than 60 are labeled as retired if all of the following three conditions hold (1) we see them receiving at least 1,000,000 ISK (approximately 10,000 USD) in pension payments over the sample period, (2) the pension payment in the current month is at least 30,000 ISK (approximately 300 USD), and (3) monthly pension payments in the following three months or the last three months amount to at least 30,000 ISK. Alternatively, we label individuals as retired if these three conditions hold and (4) we do not see a labor income payment higher than 150,000 ISK (1,466 USD) in the current month or the three months before and after. The pension payments are calculated for each individual and all bank accounts are individual-level (there are no joint accounts in Iceland). Liquidity is defined as cash holdings plus overdraft limits and credit card limits minus overdrafts and credit card balances.

Table 2: The Effects of Retirement on Personal Finances

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Overdraft indicator	# overdrafts	Overdraft interest	Late fees	Interest income indicator	Interest income	Credit lines
Without controlling for income:							
Retired receiving pensions	-0.044***	-0.043**	-0.549***	-0.249***	0.036**	0.281***	-0.060
	(0.016)	(0.021)	(0.133)	(0.081)	(0.016)	(0.098)	(0.080)
R-sqr	0.001	0.001	0.002	0.007	0.455	0.513	0.012
Retired for (months), receiving pensions:							
<12	-0.050***	-0.049**	-0.577***	-0.263***	0.042***	0.487***	-0.048
	(0.016)	(0.020)	(0.134)	(0.084)	(0.015)	(0.098)	(0.081)
$12 > < 24$	-0.037**	-0.031	-0.468***	-0.149	0.029	0.296***	-0.134
	(0.018)	(0.024)	(0.155)	(0.099)	(0.019)	(0.108)	(0.108)
> 24	-0.039**	-0.043	-0.574***	-0.319***	0.033	-0.047	-0.020
	(0.020)	(0.028)	(0.166)	(0.104)	(0.023)	(0.115)	(0.152)
R-sqr	0.001	0.001	0.002	0.007	0.455	0.513	0.012
Retired for (months), receiving pensions and low salary:							
<12	-0.052**	-0.059*	-0.585***	-0.234*	-0.009	-0.021	-0.187
	(0.021)	(0.033)	(0.195)	(0.130)	(0.024)	(0.022)	(0.123)
$12 > < 24$	-0.033	-0.014	-0.492**	-0.321*	-0.004	0.038	-0.224
	(0.025)	(0.038)	(0.216)	(0.167)	(0.035)	(0.023)	(0.189)
> 24	-0.052	-0.068	-0.675**	-0.432**	0.074*	0.061***	-0.209
	(0.031)	(0.057)	(0.270)	(0.176)	(0.044)	(0.022)	(0.194)
R-sqr	0.002	0.003	0.005	0.008	0.460	0.516	0.012
Controlling for income:							
Retired receiving pensions	-0.045***	-0.045**	-0.561***	-0.284***	0.021	0.281***	-0.058
	(0.016)	(0.021)	(0.133)	(0.081)	(0.016)	(0.098)	(0.080)
R-sqr	0.002	0.002	0.003	0.009	0.463	0.513	0.012
Retired for (months), receiving pensions:							
<12	-0.051***	-0.051**	-0.590***	-0.300***	0.020	0.487***	-0.047
	(0.016)	(0.020)	(0.134)	(0.084)	(0.015)	(0.098)	(0.081)
$12 > < 24$	-0.038**	-0.032	-0.480***	-0.182*	0.013	0.296***	-0.133
	(0.018)	(0.024)	(0.155)	(0.099)	(0.018)	(0.108)	(0.109)
> 24	-0.041**	-0.044	-0.587***	-0.355***	0.029	-0.047	-0.018
	(0.020)	(0.028)	(0.166)	(0.104)	(0.022)	(0.115)	(0.152)
R-sqr	0.002	0.002	0.003	0.009	0.463	0.513	0.012
# obs	746,669	746,669	746,669	746,669	746,669	746,669	331,487
# individuals	12,143	12,143	12,143	12,143	12,143	12,143	12,143
Individual FE	✓	✓	✓	✓	✓	✓	✓
Month-by-year FE	✓	✓	✓	✓	✓	✓	✓

Notes: [a] This table shows regression results of the effect of retirement on log interest payments, balances, and limits, using individual fixed effects, with and without controlling for total income. All specifications control for month and year fixed effects as well as their interactions, i.e., month-by-year fixed effects. All coefficients represent percentage changes. All continuous variables are measured in terms of their inverse hyperbolic sine to accommodate observations with zero values. Standard errors are clustered at the individual level and displayed in parentheses. We define credit lines as overdraft limits and credit card limits minus overdrafts and credit card balances normalized by monthly income. Late fees are fees assessed for paying bills after their due dates.
[b] Significance levels: * $p<0.1$ ** $p<0.05$ *** $p<0.01$

Table 3: The Effects of Retirement on an Indicator for Paying Overdraft Interest or Interest Earnings from Savings - Different Specifications

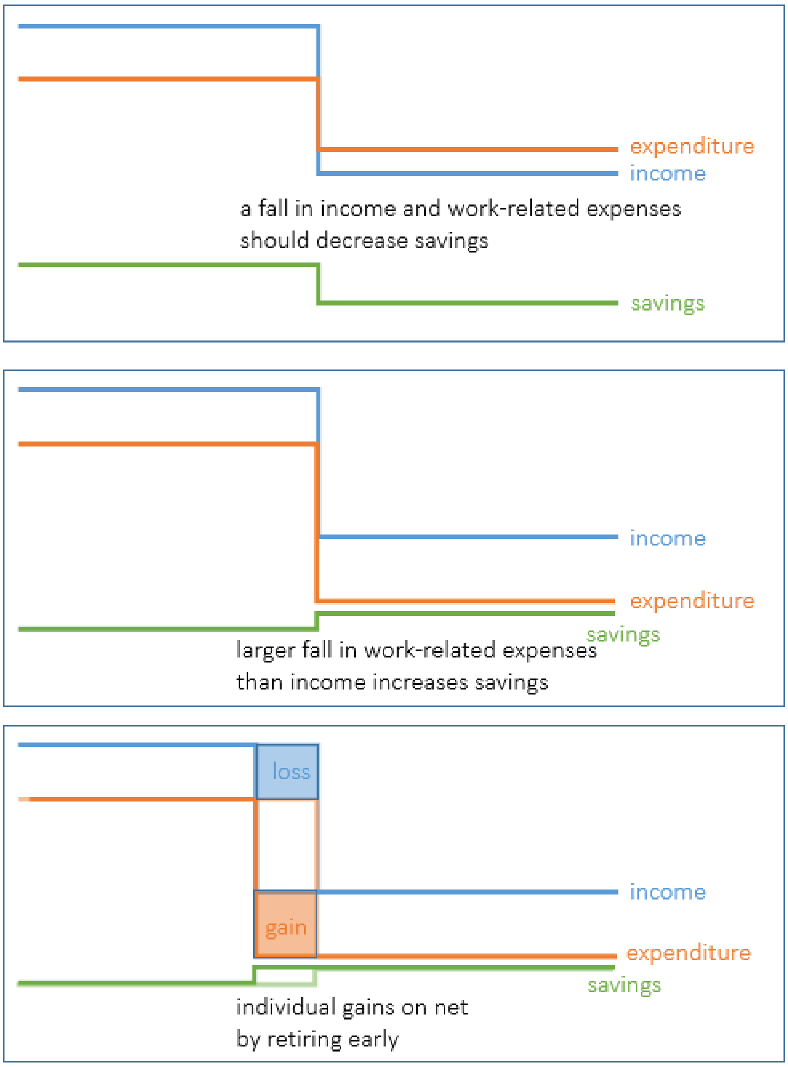
	(1)	(2)	(3)	(4)
FE type:	None	Individual	Individual month, year	Individual month-by-year
Effects on Indicator for Paying Overdraft Interest:				
Retired	-0.089***	-0.047***	-0.044***	-0.044***
	(0.017)	(0.015)	(0.016)	(0.016)
R-sqr	0.001	0.000	0.001	0.001
# obs	746,669	746,669	746,669	746,669
Effects on Indicator for Interest Earnings from Savings:				
Retired	0.196***	0.365***	0.035**	0.036**
	(0.015)	(0.016)	(0.016)	(0.016)
R-sqr	0.005	0.006	0.419	0.455
# obs	886,439	886,439	886,439	886,439
# individuals	12,143	12,143	12,143	12,143

	(1)	(2)	(3)	(4)
Income control:	Income	Regular income	Irregular income	Pension
Effects on Indicator for Paying Overdraft Interest:				
Retired	-0.044***	-0.044***	-0.044***	-0.047***
	(0.016)	(0.016)	(0.016)	(0.016)
R-sqr	0.001	0.001	0.001	0.001
# obs	746,669	746,669	746,669	746,669
Effects on Indicator for Interest Earnings from Savings:				
Retired	0.036**	0.036**	0.036**	0.032**
	(0.016)	(0.016)	(0.016)	(0.016)
R-sqr	0.455	0.455	0.455	0.455
#obs	886,439	886,439	886,439	886,439
# individuals	12,143	12,143	12,143	12,143
Individual FE	✓	✓	✓	✓
Month-by-year FE	✓	✓	✓	✓

Notes: [a] This table shows the estimated effect of retirement on overdraft interest and interest earnings from savings accounts using different fixed effects regimes and control variables. The top four specifications include fixed effects regimes as indicated in each column, the bottom four specifications control for individual as well as interacted month and year fixed effects, i.e., month-by-year fixed effects. Standard errors are clustered at the individual level and are within parentheses. [b] Significance levels: * $p<0.1$ ** $p<0.05$ *** $p< 0.01$

A Appendix

Figure A.1: Illustration of the argument



This figure illustrates why a rational model has difficulty explaining our two findings that 1) individual savings increase after retirement and 2) eligible individuals do not retire immediately. A fall in income and work-related expenses (or any other theory that would decrease consumption, such as a health shock) will only increase savings if work-related expenses (or the fall in consumption more generally) are larger than the fall in income. However, in that case, the individual gains on net in life-time resources if she retires early.

Table A.1: The Effects of Retirement on Investment Transactions and Uncategorized Income

	Investment transactions	Uncategorized income	Investment transactions	Uncategorized income
Retired	-0.000	-0.071**	-0.017	-0.096**
	(0.013)	(0.029)	(0.012)	(0.040)
R-sqr	0.024	0.024	0.032	0.035
#obs	886,439	886,439	7466,69	746,669
#individuals	12,143	12,143	12,143	12,143
Individual FE	✓	✓	✓	✓
Month-by-year FE	✓	✓	✓	✓
Controlling for income			✓	✓

Notes: [a] This table shows regression results of the effect of retirement on log investment related income and uncategorized income. All specifications control for month and year fixed effects as well as their interactions, i.e., month-by-year fixed effects. Standard errors are clustered at the individual level and displayed in parentheses. All coefficients represent percentage changes. [b] Significance levels: * $p<0.1$ ** $p<0.05$ *** $p< 0.01$

Table A.2: The Effects of Retirement on Expenditures by Category

	Total expenditure	Grocery	Fuel	Alcohol	Ready-made -food	Home improvement	Home security	Transportation	Clothing and accessories	Sports and activities	Pharmacies
Without controlling for income:											
Retired	-0.216***	-0.236***	-0.314***	-0.265***	-0.188**	-0.141	-0.118	-0.329***	-0.204**	-0.240***	-0.074
	(0.0433)	(0.0729)	(0.1016)	(0.0893)	(0.0800)	(0.0858)	(0.0809)	(0.0886)	(0.0816)	(0.0690)	(0.0886)
R-sqr	0.049	0.043	0.014	0.024	0.044	0.052	0.003	0.038	0.034	0.006	0.009
Controlling for income:											
Retired	-0.268***	-0.303***	-0.381***	-0.307***	-0.250***	-0.201**	-0.124	-0.382***	-0.259***	-0.259***	-0.123
	(0.0416)	(0.0702)	(0.1012)	(0.0886)	(0.0781)	(0.0849)	(0.0809)	(0.0880)	(0.0806)	(0.0688)	(0.0869)
R-sqr	0.074	0.060	0.022	0.026	0.055	0.055	0.003	0.041	0.036	0.006	0.012
#obs	787,316	787,316	787,316	787,316	787,316	787,316	787,316	787,316	787,316	787,316	787,316
#individuals	12,143	12,143	12,143	12,143	12,143	12,143	12,143	12,143	12,143	12,143	12,143
Individual FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Month-by-year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes: [a] This table shows regression results of retirement on log spending by category using individual fixed effects and a dummy for retirement, with and without controlling for total income. All specifications control for month and year fixed effects as well as their interactions, i.e., month-by-year fixed effects. Standard errors are clustered at the individual level and displayed in parentheses. All continuous outcome variables are measured in terms of their inverse hyperbolic sine to accommodate observations with zero values. All coefficients represent percentage changes. [b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

Table A.3: The Effects of Retirement on Restaurant Expenditures and Visits

	Total spending	Casual dining	Cold dishes	Fast food	Fine dining	Bakeries	Cafes	Bars	Meal kit delivery	Canteens
Without controlling for income:										
Retired	-0.188**	-0.370***	-0.097	-0.328***	-0.143**	-0.055	-0.087	-0.230***	-0.172***	-0.096***
	(0.0800)	(0.0912)	(0.0706)	(0.0953)	(0.0588)	(0.0903)	(0.0768)	(0.0314)	(0.0224)	(0.0208)
R-sqr	0.044	0.024	0.005	0.028	0.006	0.018	0.012	0.008	0.028	0.012
Controlling for income:										
Retired	-0.250***	-0.425***	-0.106	-0.386***	-0.165***	-0.096	-0.120	-0.251***	-0.174***	-0.094***
	(0.0781)	(0.0904)	(0.0704)	(0.0943)	(0.0588)	(0.0898)	(0.0768)	(0.0315)	(0.0224)	(0.0208)
R-sqr	0.055	0.028	0.005	0.034	0.007	0.020	0.013	0.009	0.028	0.012
Number of visits										
Without controlling for income:										
Retired	-1.549***	-0.327***	-0.015	-0.393***	-0.032***	0.023	-0.035	-0.129***	-0.037***	-0.030*
	(0.2274)	(0.0427)	(0.0162)	(0.1049)	(0.0114)	(0.0687)	(0.0311)	(0.0146)	(0.0044)	(0.0167)
R-sqr	0.019	0.013	0.003	0.013	0.005	0.012	0.005	0.005	0.022	0.008
Controlling for income:										
Retired	-1.758***	-0.353***	-0.017	-0.467***	-0.036***	0.003	-0.049	-0.138***	-0.037***	-0.028*
	(0.2264)	(0.0424)	(0.0162)	(0.1049)	(0.0114)	(0.0685)	(0.0314)	(0.0147)	(0.0044)	(0.0167)
R-sqr	0.022	0.014	0.004	0.016	0.005	0.013	0.005	0.006	0.022	0.007
# obs	787,316	787,316	787,316	787,316	787,316	787,316	787,316	787,316	787,316	787,316
# individuals	12,143	12,143	12,143	12,143	12,143	12,143	12,143	12,143	12,143	12,143
Individual FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Month-by-year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes: [a] This table shows regression results of retirement on spending in different types of restaurants and on the number of visits to different types of restaurants, with and without controlling for total income. All specifications control for individual fixed effects, as well as month and year fixed effects as well as their interactions, i.e., month-by-year fixed effects. Standard errors are clustered at the individual level and displayed in parentheses. Expenditures are measured in terms of its inverse hyperbolic sine to accommodate observations with zero values. All coefficients represent percentage changes. [b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

Table A.4: The Effects of Retirement on Expenditures and Savings in Simulated Data

	Standard agent	News-utility agent	Hyperbolic agent	Tempted agent
Consumption Regressions:				
Retired	0.06***	-0.38***	-0.14***	-0.004***
	(22.67)	(-94.40)	(-44.76)	(-1.42)
Controlling for income	✓	✓	✓	✓
#obs	800	800	800	800
Savings Regressions:				
Retired	-0.006***	0.052***	0.016***	-0.0004***
	(-21.93)	(86.56)	(44.61)	(-1.37)
Controlling for income	✓	✓	✓	✓
#obs	800	800	800	800

Notes: [a] The table displays the regression results for 200 agents and their simulated data points for four years around the retirement date. The displayed regression coefficients represent the percentage fall or increase in consumption and savings due to retirement. The corresponding t-statistics are displayed in parentheses.
[b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

B Detailed Description of the Dataset

We study a subsample of 12,143 active users with complete records, i.e., for whom we observe all balances, labor income arrivals, and transactions. All individuals in that sample have passed an "activity test" that is designed to verify that we are capturing all of their relevant financial information. More specifically, our user sample is restricted to individuals with complete records, defined by four requirements. First, we restrict our sample to individuals for whom we see bank account balances and credit lines. Second, we restrict our sample to individuals for whom we observe income arrivals (this does not only include labor market income but also, e.g., unemployment benefits, pension payments, disability benefits, and student loans). The third requirement is that key demographic information about the user is available (age, sex, and postal code). The final requirement is that the consumption of each user must be credible, which we ensure by requiring at least five food transactions per month in at least 23 months of a 24-months period. This activity test is designed so that we do not exclude any subsamples of the population, such as low income or uneducated consumers; it is designed to exclude individuals for whom we do not observe the whole financial picture because they did not link all of their financial accounts. We do not see more account-linking or app-joining activity before versus after retirement. We perform all our analysis on this final sample and consider individuals eligible for retirement after they reach age 60 for the summary statistics that we report. The data on spending by category, income by source, overdraft interest, and bank fees run from 2011 to 2017 and the data on balances and limits span from 2014 to 2017. We perform the analysis on user-level data aggregated at a monthly level.

Categorizing transactions

When the data are extracted from the personal financial management (PFM) system, they have already been categorized by a three-tiered approach: system, user, and community rules. The system rules are applied when codes from the transaction system clearly indicate the type of transaction being categorized. For example, when transactions in the Icelandic banking system contain the value "04" in a field named "Text key," the payer has indicated payment of labor income. User rules apply when there are no system rules in place. If a user persistently categorizes transactions with certain text or code attributes to a specific category, the system will automatically create a rule that is applied to all future transactions. If neither system rules nor user rules apply, the system detects identical categorization rules from multiple users, which allows it to generate a community rule that applies the categorization across the entire community. The PFM system has already detected first-party transactions, such as transfers between two accounts belonging to the same individual, and excluded them. Thus, multiple steps were taken to achieve an accurate categorization of transactions based on banking system codes, transaction texts, amounts, and payer profiles.

Spending

For spending, we obtain categorized data on all transactions based on the type of retailer, and each category can be aggregated to both the individual and the household level. Thus, the panel provides individual- and household-level expenditure information for a number of spending categories. We consider 10 fairly broad categories: groceries, fuel, alcohol, ready-made food, home improvement, transportation, clothing and accessories, sports and activities, and pharmacies.[12] We also have more disaggregated categories. For example, for ready-made food, we know the type of restaurant, such as bakery, canteen, or fine dining. We consider only discretionary spending, such as on groceries and clothing, and exclude recurring expenditures like rents, utilities, or phone bills.

Income

Payer identity and NACE category (The Statistical Classification of Economic Activities in the European Community)[13] are added to each income transaction whenever possible.[14] This enables us to sort income into 21 categories. Regular income categories are labor income, student loans, rental income, rental interest, child support, child benefits, disability benefits, parental leave, pensions, housing benefits, rental benefits, unemployment benefits, and other social benefits. The irregular income categories are damages, grants, insurance claims, investment transactions, reimbursements, tax rebates, travel allowances, and other income.

We generally call income all incoming transactions or inflows. Thus, when retirees receive their annuitized pension payments, such income is effectively dissaving their pension assets. That said, we call it pension income and then look at liquid savings in bank accounts rather than considering the dissaving in pension assets. Furthermore, when individuals sell investment assets, we observe investment income, and other sale transactions are contained in an unclassified incoming transaction category or "other income."

Bank account information

The amount of savings and overdrafts that individuals hold can be inferred from information on balances, interest income from savings accounts, and interest paid on overdrafts. An overdraft occurs when withdrawals from a checking account exceed its available balance. This means that the balance is negative and the bank is providing credit to the account holder, with interest being charged at the agreed-upon rate. Virtually all checking accounts in Iceland offer a pre-agreed upon overdraft facility, the limit of which is based on individual credit scores and histories. Customers can use this overdraft facility at any time without consulting the bank, and it can be maintained indefinitely. Although an overdraft facility may be authorized, technically the money is repayable on demand by the bank. In reality, this is a rare occurrence, because the overdrafts are profitable for the bank and expensive for the customer. In Iceland, individuals rarely roll over credit card debt. Instead they repay their credit cards in full each month (in fact, the automatic payment is mandated for the vast majority of credit cards) and then roll over overdraft debt instead.

From the information on checking account balances, overdrafts, overdraft limits, savings account balances, credit card balances, and credit card limits, we create a measure of individuals' cash holdings and liquidity. Cash holdings are defined as checking account balances plus savings account balances. Liquidity is defined as cash holdings plus overdraft limits and credit card limits minus overdrafts and credit card balances. Furthermore, we define credit lines as overdraft limits and credit card limits minus overdrafts and credit card balances normalized by

[12] We can observe expenditures on alcohol that is not bought at bars and restaurants because a state-owned company, the State Alcohol and Tobacco Company, has a monopoly on the sale of alcoholic beverages in Iceland.

[13] This is the industry classification system used in the European Union.

[14] Payer identity can be hard or impossible to identify because of limited information in transaction data, such as generic transaction texts. In specific cases where the payer could not be identified, a proxy ID was created to enable the collection of payments from the same sources even though the true source ID is unknown. All of these transactions are categorized as "other income."

monthly income. We also have information on interest income from bank accounts and interest paid on overdrafts. We use these two variables as our measure of liquid savings and rolled over high-interest unsecured consumer debt.

Interest income and overdraft interest expenses are both affected by the interest rates, and different individuals get different interest rates (for instance, for different savings accounts, the interest rate may vary depending on the length of the fixed-term deposit). We thus always use an overdraft interest expense indicator as well as an interest income indicator to measure the likelihood of having an overdraft and receiving interest income in a given month. The indicator measures are not influenced by different levels of interest rates.

In addition, we have information on three types of financial penalties: late payment interest, insufficient funds fees, and late fees. Credit card companies charge late payment interest daily from the date a payment is due and payable to the date it is paid in full. Insufficient funds fees occur when the overdraft limit is exceeded in a consumer's checking account. In the event of attempted debit card transactions, the bank charges the account with these fees. Finally, late fees are fees assessed for paying bills after their due dates.

B.1 Summary statistics

In Olafsson and Pagel (2018a), we discuss in detail the spending, income, and demographic summary statistics of our user population and how they compare to those of the representative consumer survey of Statistics Iceland. Overall, our demographic statistics are similar to those of the overall population. This is reassuring as, when using app data, there is a concern that the user population is very young, well-situated, male, and tech-savvy. Our summary statistics are very similar to those of the overall population because the app is marketed to consumers through their online banking interface. As mentioned, banks offer individuals the opportunity to sign up for the software when they access their bank accounts online, and the online banking penetration is 94 percent in Iceland.[15] Moreover, even if individuals never use the software or app, the moment they sign up, we obtain their data.

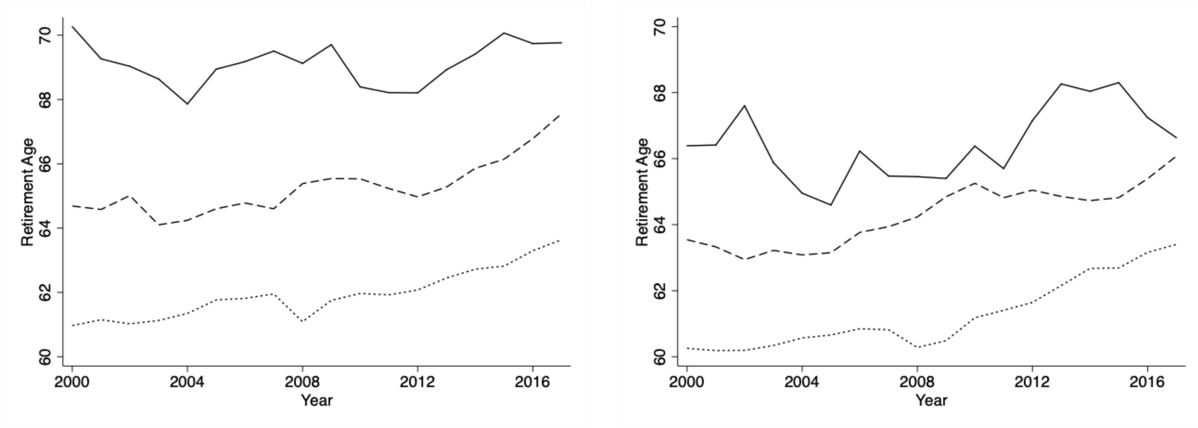
As discussed in Subsection 2, Figure 1 displays the share of retired individuals at each age. Our inferred time of retirement is consistent with the information from the OECD on effective retirement age in Iceland.

Table 1 displays summary statistics for retired and non-retired individuals who are eligible for retirement, i.e., have reached age 60, and who we observe as retired at some point during our sample period. We can see in the raw data that, on average, retired individuals have lower incomes, are more likely to hold liquid savings and less likely to hold consumer debt, pay less interest on their overdrafts, and incur fewer late fees. Note that spending reflects discretionary categories only and excludes recurring expenses such as rent and bill payments.

As discussed in Subsection 2, we consider two definitions of retirement, i.e., when we condition only on the presence of pension payments or when we condition on both the presence of pension payments and the absence of labor income. Note that, for the first definition of retirement, which conditions only on the presence of retirement income but not the absence of labor income, there is no drop in spending at retirement in the raw data mean averages. This cross-sectional mean comparison can be affected by outliers, time trends, and selection, which our regression specifications will take care of with month-by-year and individual fixed effects. For the second definition of retirement, we see a pronounced decrease in spending in the simple comparison of means in the raw data.

[15] According to Eurostat, 94 percent of Icelanders used internet banking in 2018. Source: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_bde15cbc&lang=en

A long working life is common in Iceland. Figure B.2 compares the average effective retirement ages of men and women in Iceland, Germany, and the United States. This data is obtained from the Organization for Economic Co-operation and Development (OECD).



Men

Women

Figure B.2: Average Retirement Age by Year for Iceland, Germany, and the US
Notes: For men and women in Iceland (solid line) compared to Germany (dotted line) and the United States (dashed line). Source: OECD.

C Potential theoretical explanations of our findings

We loosely categorize potential explanations for our findings as follows: We first consider explanations that are consistent with rational planning for retirement, in the sense that they do not feature a limited rationality component, such as cognitive or planning constraints, or a behavioral component, such as non-standard preferences or beliefs. We then move on to explanations that have a limited rationality or behavioral component. We single out two widely-applied and highly-cited preference theories that are likely candidates to explain our findings: present bias that is corrected at retirement and expectations-based loss aversion. We then consider a full-fledged, life-cycle model and show that our non-standard preferences generate a simultaneous drop in consumption at retirement and an increase in savings by running our empirical specification in the simulated consumption data.

C.1 Explanations consistent with rational planning

In principle, any rational agent will save before retirement, given that she expects a fall in income, and dissave after. However, we observe that individuals do the opposite: they dissave before and save after retirement. Thus, the joint observations of a fall in income, a fall in consumption, a decrease in consumer debt, and an increase in savings may be difficult to reconcile with a rational model of consumption smoothing. In the following, we discuss whether work-related expenses and health shocks coupled with medical expense risks can explain our findings as these are the leading explanations for the retirement-consumption and savings puzzles. We then discuss some additional potential explanations for our findings consistent with rational planning, but we conclude that all have difficulty explaining our findings.

Work-related expenses

If work-related expenses are larger than the difference between pension and labor income, then individuals would increase savings at the start of retirement. However, in this case, individuals should retire early unless the additional monthly pension benefits for an additional month of work exceed the savings from retiring. That said, only near the retirement benefits thresholds ages of 60, 65, 67, and 70, the additional benefits increase discontinuously. Between the ages of 67 and 72, the additional pension benefit from one month of work is very small: approximately 0.5 percent or 10 USD per month (as discussed in Section 2 and Appendix E). This additional monthly benefit of 0.5 percent is much smaller than the 50 percent reduction in overdrafts and increases in liquid savings we observe. Note that, the initial positions in overdraft debt and liquid savings are large and equal more than one month of pension income. In Table 1, we can see that the average overdraft interest per month equals 24 USD which implies that, at 13 percent annualized interest over the sample period, the overdraft balance is 24*12/0.13 = 2,215. The average interest income is 45 which implies that, at 6 percent annualized interest, the savings account balance is 9,000. A 55 percent reduction in overdrafts and a 28 percent increase in savings equal monthly repayment of overdrafts in the neighborhood of 0.55*2,215/12 = 102 USD and increases in savings balances of approximately 210 USD per month. Individuals thus save much more than the additional 10 USD per month or 7 percent per year they would receive in pension payments (which equal 1,899 USD on average as displayed in Table 1). Therefore, if consumption falls by more than income because of work-related expenses, individuals should retire earlier.

However, as Figure 1 shows, there are no discontinuities in the fraction of individuals retiring at the retirement age thresholds of 60, 65, 67, and 70. A mass of individuals retires at age 60, but this is a mechanical effect, because we start defining individuals as retired after they reach age 60. Since we restrict the analysis to individuals over 60 and include individual fixed effects, we do not identify our effects based on this mass. Furthermore, there is no discontinuous increase in the number of retirees at age 65 or 67; if anything, the mass is larger at ages 64 and 69. We thus conclude that individuals do not immediately retire at the benefits thresholds. On average, individuals appear to retire voluntarily at least a couple of months after they reach the age thresholds and oftentimes years after. The average retirement age is 70 years or 71 years if the retirement definition also conditions on the absence of all labor income as shown in Table 1. The results for consumer debt do not depend on the definition of retirement but the effect on savings is slightly larger for the first definition of retirement. This makes sense as for the first definition of retirement we see a smaller drop in income than for the second. Our results thus square with the known comparative static documented in (see Bernheim et al., 2001, among others): when the drop in income is larger, there is a larger drop in consumption.

Our argument is illustrated in Figure A.1. In a rational model, if an agent expects a fall in income and expenditures, then savings will increase as long as the fall in spending is smaller than the fall in income. If the fall in spending is larger than the fall in income, then savings will increase. In that case, however, the agent gains on net by retiring early when the gain from retiring is larger than the small increase in income after retiring. Overall, we thus conclude that work-related expenses, while certainly present, are unlikely to explain our finding that savings increase after retirement without additional assumptions about how information or expectations change at retirement. In general, it appears non-trivial to explain, in any rational model, the joint observation that savings increase after retirement and individuals who are eligible do not retire immediately. We now discuss what other explanations (i.e., shocks or omitted variables) may drive the decision to retire, the fall in spending, and the increase in savings.

In order to explain our joint findings with work-related expenses, we thus need to model why the agent kept working, for instance, it could be that individuals derive utility from working even though they could save money by retiring. Alternatively, we may assume that the marginal utility of consumption changes unexpectedly with individual work status (Laitner and Silverman, 2005; French, 2005; Han et al., 2019), which we briefly discuss now as they might be simply reinterpreted as a reduction in work-related expenses.

Health shocks and medical expense risk

Individuals may choose to retire in response to an adverse health shock. It could be that a health shock makes spending less enjoyable or increases a precautionary savings motive, which then increases savings by reducing consumption and, at the same time, explains why the individual retires. However, for the following three reasons, we do not think that health shocks in combination with medical expense risk can fully explain our findings.

First, we find that pharmacy spending is insignificant but qualitatively falls upon retirement by 7.4 percent (12.3 percent after controlling for income) with a standard error of 8.86 percent (8.69 percent). This suggests that health shocks are not the reason the average individual in our sample retires. When individuals buy medical supplies, they do so in pharmacies and must make a copayment. Copayments are capped at a certain level of expenditures on medicine in a given year. Therefore, for people who were at or above the threshold before retirement, we would expect no change, but for people below the threshold, we would expect an increase in expenditures up to the cap if it were in fact health shocks that caused the individuals to retire. However, the documented drop in healthcare expenditure shows that this is not the case for the average individual. That said, we have to note that pharmacy spending may drop because individuals also buy household goods, such as cosmetics, in pharmacies. Such expenses may be work-related, but they are typically much lower than the average copayment for medicals. Thus, while pharmacy spending is not a perfect measure, the large fall we document seems inconsistent with health shocks being the predominant reason that individuals retire. Second, the Icelandic health care system is very comprehensive relative to the US one and there are no large expense risks such as those that individuals in the US face. Third, even if a strong precautionary savings motive because of health expenses is there, it should be present before retirement and not only after, i.e., individuals should start saving for medical expenses before rather than at the time of retirement.

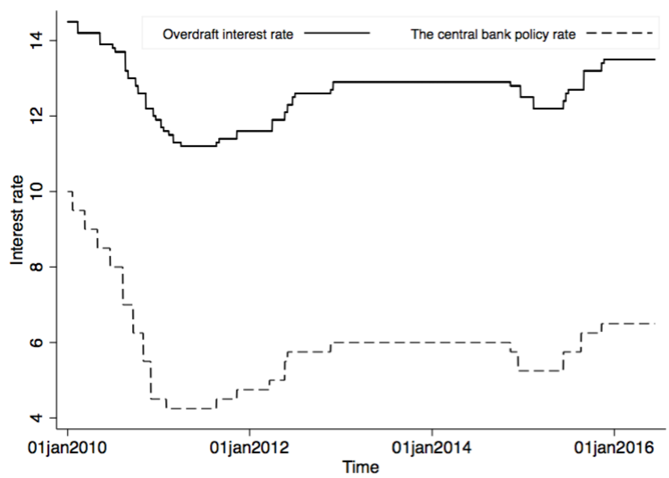
In order to explain our joint findings with health shocks and medical expense risk, we thus need to assume that the marginal utility of consumption changes unexpectedly with individual health (Finkelstein et al., 2013; Brown et al., 2016; Bound et al., 2010).

Wealth s|hocks, liquidation of assets, and returns of savings versus borrowing

Individuals may sell their house or liquidate other assets upon retirement. However, our findings are robust to controlling for all income, which includes other income (e.g., other income contains any other inflows such as housing transactions and uncategorized investment transactions). Furthermore, we can more directly address this concern by estimating the effect of retirement on investment income and uncategorized income. As discussed, investment transactions are identified via the transaction-system categorization, and income that cannot be classified is listed as "uncategorized" income and could be due, for example, to the sale of real estate or other assets. We therefore estimate the effect of retirement on these two income categories, and the results can be found in Table A.1. The fact that we do not find an effect on investment-related income and a negative effect on uncategorized income should relieve concerns about liquidation of assets or housing transactions. We also ensure that our results are not affected when we control for individual as opposed to total household income, i.e., the total income of two linked spouses in Table 3.

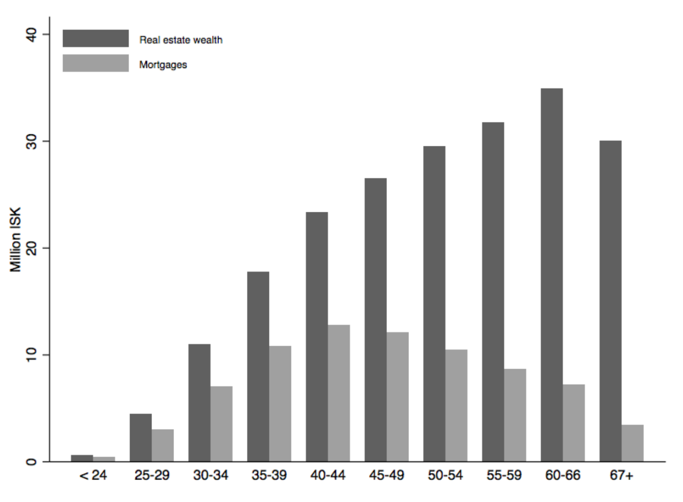
Another concern related to housing is that individuals wait to retire until they have paid off their mortgages, in which case their increase in savings and decrease in consumer debt is only a consequence of the reduced debt burden after making the final mortgage payment. However, we do not see a sharp decline in mortgage debt by individuals who have reached the official retirement age, as can be seen in Figure C.4. A large fraction of mortgage debt is paid off before individuals reach age 60, and the remainder declines smoothly as individuals reach average retirement age.

Figure C.3: Central Bank Policy Rate and Average Overdraft Interest Rate



Notes: Trends of the central bank policy rate and average overdraft interest rate through the sample period. Data source: Central Bank of Iceland https://www.cb.is/ Our data on spending by category, income by source (including interest income), overdraft interest, and financial fees run from 2011 to 2017 and the data on balances and limits spans 2014 to 2017.

Figure C.4: Housing Wealth and Mortgage Debt over Age



Notes: This figure plots the amount of mortgage debt and housing wealth (source: Statistics Iceland) over age.

Credit constraints, consumption insurance, inventory considerations, or lump-sum pension withdrawals

It could be that banks reduce individuals' overdraft or credit limits when they observe them retiring. However, we do not find significant effects on overdraft limits, credit limits, credit lines, or liquidity and can thus rule out this explanation (see Table 2).

Alternatively, the reduction in the likelihood of overdrawing the checking account in a given month may be brought about by reduced income uncertainty once individuals retire. Indeed the standard deviation of income is lower after retirement and thus individuals may use overdraft debt less as a vehicle to insure against transitory shortfalls in income. However, we find significant and large reductions, not only in the likelihood of having an overdraft but also in the amounts of overdrafts. Furthermore, the baseline likelihood of having an overdraft is almost 50% in our sample of working individuals but still 38% for our sample of retired individuals. Thus, even retired individuals use overdrafts happily despite the absence of large variation in income. For our alternative definition of retirement, we observe very little irregular income uncertainty and thus do not think that, in the baseline, the 31% of times that individuals overdraw the checking account are driven by transitory income shocks. Furthermore, in general, overdraft debt is not negatively correlated with income, as consumption insurance would predict, as we show in two related papers (Hundtofte et al., 2019; Olafsson and Pagel, 2019). Instead, overdrafts are very persistent at the individual level. Finally, the explanation of less need for transitory income insurance after retirement that decreases overdrafts is not consistent with the simultaneous increase in savings that we observe. Income insurance would predict the need for liquid savings to decrease after retirement, which we do not find in any specification or for either definition of retirement.

If individuals were to withdraw their pension payments less frequently after retirement than they received their labor income before retirement, then, logically, they should keep a larger inventory of balances in their checking and savings accounts. The occupational pension as well as the means-tested pension is paid out in a monthly fashion, as is the labor income of the vast majority of working individuals. In principle, voluntary pensions can be withdrawn in any fashion after the age of 60 (free of restrictions or transaction costs), however, in practice we do not observe lump-sum withdrawals for the average individual as the standard deviation of income after retirement is very low.

C.2 Explanations based on limitations to rationality or non-standard preferences

The existing literature rationalizing the drop in consumption at retirement can be loosely classified into two types of models: first, there are models based on limitations to rationality that are reflected in non-standard information, attention, or expectations as well as insufficient planning; second, there are models of non-standard preferences that generate an overconsumption problem before retirement. We now discuss whether the two types of models may be able to explain an increase in savings at retirement on top of a fall in consumption.

Overconsumption and present bias, insufficient planning, liquidity constraints, and expectations-based loss aversion

There is widespread evidence for individuals having overconsumption problems (refer to Do, 2011, for a literature survey). The most highly-cited and widely-applied models of overconsumption are based on quasi-hyperbolic discounting preferences, as in Laibson et al. (1998)

and Laibson et al. (2007). Hyperbolic discounting preferences cannot generate a drop in consumption at retirement per se because the agent is equally impatient before and after retirement and can smooth consumption.

This model as well as the limited-attention insufficient-planning life-cycle models (Huang and Caliendo, 2011; Caliendo and Aadland, 2007; Gabaix, 2016; Reis, 2006; Campbell and Mankiw, 1989) may generate a drop in consumption at retirement if liquidity constraints are binding but not a simultaneous increase in savings. However, empirically, we see individuals having substantial liquidity. Furthermore, if individuals hit their liquidity constraint, their savings would be zero before retirement. If income falls at retirement, their savings will be zero after retirement as well. Clearly, however, savings would not increase in this case: if individuals consume their entire income when it is high, they will also do so when it is low.

To rationalize a drop in consumption and an increase in savings after retirement in the hyperbolic-discounting framework, one needs to assume that the hyperbolic discount factor changes when the individual retires. This change could be interpreted as a change in the agent's patience, but it could also be interpreted as a change in the agent's information or planning abilities. Fixed or endogenous attention costs or the freeing up of cognitive resources allows individuals to reconsider their savings and consumption plans upon retirement. This theory would predict a systematic reduction in debt and an increase in savings if insufficient attention or time for planning results in overconsumption before retirement that is corrected after retirement (Haider and Stephens, 2007; Ameriks et al., 2007; Mullainathan et al., 2007; Carvalho et al., 2016). As alternative explanation, we could think of models of salience, memory, focusing, or relative thinking (Bordalo et al., 2013, 2017; Koszegi and Szeidl, 2013; Bushong et al., 2015). It could be that income and spending after retirement are more salient, memorable, focused, or easier to compare in relative terms, which would all imply a change in planning behavior around retirement. The insufficient planning or salience models can be combined with an update in information or planning ability to generate an increase in savings on top of a drop in consumption at retirement. Again, this class of models could be captured in a change in the effective time-inconsistency problem.

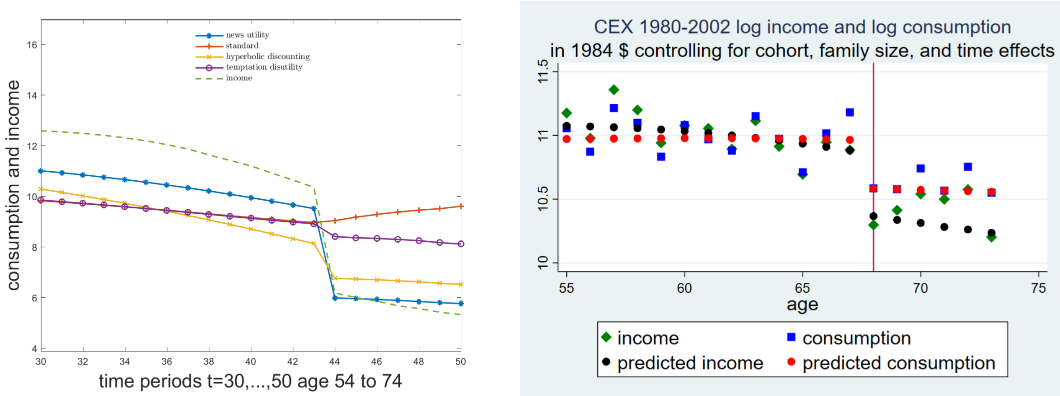
Kőszegi and Rabin (2009) and Pagel (2017) show that expectations-based, reference-dependent preferences predict that the degree of present bias depends on the level of income uncertainty, which is lower after retirement. In this model, individuals reduce their overconsumption after the start of retirement and thus may simultaneously decrease their consumption and increase their savings. Furthermore, the preferences in Kőszegi and Rabin (2009) have been widely applied and the papers Kőszegi and Rabin (2006, 2007, 2009) are the most cited models of beliefs-based preferences (Olafsson and Pagel, 2018b), which makes it worthwhile to see how far their predictive power extends to this "out-of-sample" test.

C.2.1 A quantitative exploration of the preference-based explanations in a life-cycle model

In this subsection, we illustrate a fully-fledged, life-cycle model with different preference specifications to assess which preference specifications generate a simultaneous drop in consumption and increase in savings at retirement.

We consider four preference specifications: standard, hyperbolic, temptation-disutility, and expectations-based reference-dependent preferences. For hyperbolic-discounting preferences, we assume that the agent is subject to present bias before retirement but not after; that is, his hyperbolic discount factor is less than one before retirement but equal to one after. For the temptation-disutility preferences, we also assume that the agent only experiences temptation

Figure C.5: Life-cycle Profiles and CEX Consumption and income data



Notes: This figure contrasts the five agents' consumption paths with the average CEX consumption and income data. The unit of consumption and income is the log of 1984 dollars controlling for cohort, family size, and time effects. The parameter values are $\mu_T = \mu_P = 0$, $\sigma_T = \sigma_P = 0.1$, $p = 0.01$, , $r = 0.01$, and G_t is estimated from the CEX data. The preference parameters are $\beta = 0.97$, $\theta = 2$, $\eta = 1$, $\lambda = 2$, $\gamma = 0.7$, the hyperbolic discounting parameter is $b = 0.7$, and the temptation-disutility parameter is $\tau = 0.1$. The standard agent's exponential discounting parameter β is 1 after retirement, the hyperbolic discounting parameter is 1 after retirement, and the temptation-disutility parameter is 0.

disutility before retirement, not after. For the standard agent, we also assume that the exponential discount factor increases to one after retirement, so that he becomes more patient as well.

Figure C.5 contrasts the four agents' consumption paths with the empirical consumption and income profiles from the CEX data. Hyperbolic-discounting preferences push the consumption profile upward at the beginning and downward at the end of life. Temptation disutility also causes overconsumption at the beginning of life, which decreases when consumption opportunities are depleted. Standard, hyperbolic-discounting, news-utility, and temptation-disutility preferences all generate a hump-shaped consumption profile in line with the evidence (refer to Ameriks and Zeldes, 2004, for instance). Moreover, Figure C.5 shows a large drop in consumption at retirement, period $T-R$, for the news-utility and hyperbolic agents' consumption profiles as well as the CEX consumption data. The tempted agent's profile features a very small drop, and the standard agent's profile features only a kink. Thus, one needs a change in the degree of present bias or time inconsistency, not only the discount rate, to generate a sizable drop in consumption at retirement (temptation-disutility preferences are time-consistent preferences, as are standard preferences). Note, however, that for the standard, hyperbolic, and temptation-disutility agents, the change in consumption around retirement is only brought about by the preference parameters and a change in the effective discount factor. If the preference parameters were constant, the standard, hyperbolic, and temptation-disutility agents would smooth consumption around retirement and only the news-utility agent's consumption profile would feature a drop at retirement.

We then demonstrate the drop in a regression using simulated data. For 200 agents, indexed by i, we simulate four years of consumption and income data points, indexed by t, around the retirement date and run the regression

$$\log(C_{it}) = \widehat{\alpha} + \widehat{\beta} Retired_{it} + \widehat{\gamma} \log(Y_{it}) + \varepsilon_{it}.$$

We thus run exactly the equivalent regression in our simulated data as in our empirical analysis. We look at logged consumption as the outcome variable, control for income, and consider the coefficient of a retirement dummy $Retired_{it}$. The coefficient $\widehat{\beta}$ will then determine the percentage drop in consumption at retirement. To theoretically illustrate our statistical power, we intentionally choose a much lower quantity for the number of simulated agents. Moreover, we run the same regression but with savings, $log(X_{it} - C_{it})$, on the left-hand side. The results are shown in Table A.4. In the news-utility and hyperbolic-discounting models, we obtain a negative and significant drop in consumption, while the standard and tempted agents' coefficients are basically zero. The news-utility agent's drop in consumption is larger than the hyperbolic agent's, even though the preference parameters generating the degree of present bias, γ and b, are equal before retirement, and both agents become perfectly time-consistent after retirement, because b is equal to one after retirement and $\gamma > \frac{1}{\lambda}$.

Moreover, for the news-utility and hyperbolic agents the coefficient for savings is positive and significant, but it is negative for the other agents. Clearly, the news-utility and hyperbolic agents will also decumulate their savings after retirement. However, there is another force, the change in the degree of present bias, that can temporarily increase the agents' savings at retirement. For the news-utility agent, the fall in consumption is large enough to generate a temporary increase in savings roughly in line with what we see empirically. For the hyperbolic agent, we can also observe an increase in savings, although it is somewhat smaller. The savings coefficient of the hyperbolic agent is closer to those of the standard and tempted agents.

We can introduce work-related expenses into the model. We simply assume that consumption falls by 10 percent at the time of retirement because of work-related expenses. We then run the regressions measuring the drop in consumption at retirement, which now trivially indicate a 10 percent larger drop for all agents. However, the results for savings growth are unchanged and thus constitute another phenomenon that any model of spending around retirement should be able to rationalize. The results for savings growth are unchanged because we can simply treat work-related expenses as a reduction in income. A somewhat lower income profile before retirement will not cause an increase in savings after retirement, as long as income before retirement is higher than income after.

We now briefly discuss three possible extensions of this simple life-cycle framework, none of which, however, would materially change our results. First, we can introduce a threshold for the incentives to retire and an endogenous retirement decision. In either case, however, at the time of retirement (whether endogenously chosen or exogenously induced), the hyperbolic agent's discount factor increases, and the reference-dependent agent's income uncertainty reduces, which both causes an increase in savings because the agents stop overconsuming time-inconsistently at the time of retirement. Second, we can assume illiquid savings and credit card borrowing. In a model with illiquid savings, both the hyperbolic and reference-dependent agents would use credit card borrowing as a form of negative liquid savings. In turn, at the time of retirement, liquid savings would increase and the agents would borrow less. Third, we could assume income uncertainty even after retirement. The change in the hyperbolic agent's discount factor would not be affected and the reduction of the time-inconsistency problem for the reference-dependent agent is robust to three alternative assumptions: small income uncertainty during retirement (for instance, inflation and pension risk), potentially large discrete income uncertainty (for instance, health shocks), and mortality risk. In summary, what is necessary for the model to generate the joint finding of falling income and consumption but increasing liquid savings (or decreasing borrowing) is that the agent's degree of present bias changes at the time of retirement. As mentioned, this change could be brought about by a number of changes in the agent's information environment or to his or her limited rationality or insufficient planning.

C.2.2 A quantitative exploration of the preference-based explanations in a life-cycle model: additional detail and derivation

We consider four preference specifications: standard, hyperbolic, temptation-disutility, and expectations-based reference-dependent preferences. For the standard, hyperbolic, and tempted agents, we assume that the effective discount factor changes to generate a drop in consumption at retirement and possibly a simultaneous increase in savings. For hyperbolic-discounting preferences, we assume that the agent is subject to present bias before retirement but not after; that is, his hyperbolic discount factor is less than one before retirement but equal to one after. For the temptation-disutility preferences, we also assume that the agent only experiences temptation disutility before retirement, not after. For the standard agent, we also assume that the exponential discount factor increases to one after retirement, so that he becomes more patient as well.

We hope to thus encompass an entire class of models that, for one reason or another, cause agents to become more patient after retirement. For instance, it could be that agents become better at planning, have updates in information, or their income and spending become more salient. The only distinction we are making here is the presence of a time-inconsistency problem versus the absence of it. The hyperbolic discounting model features a change in the degree of present bias, whereas the standard and temptation-disutility models do not feature a change in the time-inconsistency problem; they just feature a change in patience.

More formally, we consider a discrete-time, life-cycle model with periods indexed by $t \in 1, ..., T$ and agents with four types of preferences: 1) standard preferences (Carroll, 1997), 2) hyperbolic-discounting preferences (Laibson et al., 1998), 3) temptation-disutility preferences (Gul and Pesendorfer, 2004), or 4) reference-dependent Kőszegi and Rabin (2009) preferences. Each preference specification can be represented by Kőszegi and Rabin (2009) preferences for certain parameter combinations. In period t, the utility function consists of the consumption utility, the contemporaneous news utility about current consumption C_t, and the prospective news utility about the entire stream of future consumption $\{C_{t+\tau}\}_{\tau=1}^{T}$. Thus, lifetime utility in each period $t \in 0, ..., T$ is

$$E_t[\sum_{\tau=0}^{T-t} \beta^\tau U_{t+\tau}] = u(C_t) + n(C_t, F_{C_t}^{t-1}) + \gamma \sum_{\tau=1}^{T-t} \beta^\tau \boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1}) + E_t[\sum_{\tau=1}^{T-t} \beta^\tau U_{t+\tau}], \qquad (2)$$

where $\beta \in [0, 1)$ is an exponential discount factor. The first term on the right-hand side of Equation (2), $u(C_t)$, corresponds to the consumption utility in period t. The other terms depend on consumption and beliefs. The second term, $n(C_t, F_{C_t}^{t-1})$, corresponds to the news utility over contemporaneous consumption; here, the agent compares his present consumption C_t with his beliefs $F_{C_t}^{t-1}$. The agent's beliefs, $F_{C_t}^{t-1}$, correspond to the conditional distribution of consumption in period t, given the information available in period $t-1$. Thus, the agent experiences news utility over "news" about contemporaneous consumption by evaluating his current consumption C_t relative to his previous beliefs $F_{C_t}^{t-1}$

$$n(C_t, F_{C_t}^{t-1}) = \eta \int_{-\infty}^{C_t} (u(C_t) - u(c)) dF_{C_t}^{t-1}(c) + \eta\lambda \int_{C_t}^{\infty} (u(C_t) - u(c)) dF_{C_t}^{t-1}(c). \qquad (3)$$

The parameter $\eta > 0$ weights the news-utility component relative to the consumption-utility component, and the coefficient of loss aversion $\lambda > 1$ implies that losses outweigh gains. The third term in Equation (2), $\gamma\sum_{\tau=1}^{T-t}\beta^{\tau}\boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1})$, corresponds to the news utility experienced in period t over the entire stream of future consumption. The prospective news utility about period $t+\tau$ consumption depends on $F_{C_{t+\tau}}^{t-1}$, the beliefs with which the agent entered the period, and on $F_{C_{t+\tau}}^{t}$, the agent's updated beliefs about consumption in period $t+\tau$. The agent experiences news utility over news about future consumption by evaluating his updated beliefs about future consumption $F_{C_{t+\tau}}^{t}$ relative to his previous beliefs $F_{C_{t+\tau}}^{t-1}$ as follows

$$\boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1})=\int_{-\infty}^{\infty}(\eta\int_{-\infty}^{c}(u(c)-u(r))+\eta\lambda\int_{c}^{\infty}(u(c)-u(r)))dF_{C_{t+\tau}}^{t,t-1}(c,r). \tag{4}$$

As can be seen in Equation (2), the agent exponentially discounts the prospective news utility by $\beta\in[0,1]$. Moreover, he discounts the prospective news utility relative to the contemporaneous news utility by a factor $\gamma\in[0,1]$. Thus, he puts a weight $\gamma\beta^{\tau}<1$ on the prospective news utility regarding consumption in period $t+\tau$. For certain parameter combinations, the Kőszegi and Rabin (2009) preferences reduce to the alternative preference specifications. For $\eta=0$ or $\lambda=1$ and $\gamma=1$, they reduce to standard preferences (Carroll, 2001; Gourinchas and Parker, 2002; Deaton, 1991). For $\eta>0$, $\lambda=1$, and $\gamma<1$, the preferences correspond to hyperbolic-discounting preferences, with the hyperbolic-discount factor given by $\frac{1+\gamma\eta}{1+\eta}$ (Angeletos et al., 2001; O'Donoghue and Rabin, 1999). More specifically, the hyperbolic agent's lifetime utility is $u(C_t^b)+bE_t[\sum_{\tau=1}^{T-t}\beta^{\tau}u(C_{t+\tau}^b)]$ where $b\in[0,1]$ is the hyperbolic-discount factor. In addition, we show results for temptation-disutility preferences, as developed by Gul and Pesendorfer (2004) and assumed in Bucciol (2012).

In the following, we describe the news-utility agent's consumption and time-inconsistency problems before and after retirement following Kőszegi and Rabin (2009) and Pagel (2017). Suppose that in periods $t\in\{T-R,...,T\}$, the agent earns income without uncertainty. If uncertainty is absent, the news-utility agent behaves like the standard agent if the discount factor on the prospective versus the contemporaneous news utility is weakly larger than the inverse of the coefficient of loss aversion $\gamma\geq\frac{1}{\lambda}$. If $\gamma<\frac{1}{\lambda}$, then the news-utility agent behaves like the hyperbolic-discounting agent, with the hyperbolic-discount factor given by $\frac{1+\gamma\eta\lambda}{1+\eta}$.

To see this, suppose that the agent allocates his deterministic cash-on-hand between present consumption C_{T-1} and future consumption C_T. Under rational expectations, he cannot fool himself, hence he will not experience the news utility in equilibrium in a deterministic model. Accordingly, his expected utility maximization problem corresponds to the standard agent's maximization problem (determined by setting present and future marginal consumption utilities equal with the discount factor and interest rate). Taking his beliefs as given, the agent deviates if the gain from consuming more exceeds the discounted loss from consuming less in the future; that is,

$$u'(C_{T-1})(1+\eta)>\beta(1+r)u'(C_T)(1+\gamma\eta\lambda).$$

Thus, he follows the standard agent's path iff the discount factor on the prospective versus the contemporaneous news utility is weakly larger than the inverse of the coefficient of loss aversion, $\gamma\geq\frac{1}{\lambda}$. In this case, the pain associated with a certain loss in future consumption is larger than the pleasure gained from present consumption. However, if $\gamma<\frac{1}{\lambda}$, the agent deviates and must choose a consumption path that just meets the consistency constraint, thereby behaving as a hyperbolic-discounting agent, with a hyperbolic discount factor of $\frac{1+\gamma\eta\lambda}{1+\eta}<1$. Thus, during retirement, the implications of the agent's prospective news discount factor γ are simple: it must be high enough to keep the news-utility agent on the standard agent's track.

After retirement, the agent is less inclined to overconsume. The basic intuition for overconsumption before retirement is that the agent consumes house money–that is, labor income that he was not certain to receive. Such uncertain income wants to be consumed before the agent's expectations catch up iff the prospective news discount factor is less than one, i.e., $\gamma < 1$. In the period just before retirement, the agent finds the loss in future consumption merely as painful as a slightly less favorable realization of his labor income, $Y_{T-1} \sim F_Y$; that is, the agent trades off being somewhere in the gain domain today against being somewhere in the gain domain in the future. By contrast, after retirement the agent associates a certain loss in future consumption with an increase in present consumption–that is, he trades off a current gain against a sure loss in the future. For example, suppose the agent's retirement period is period T only. The agent's first-order condition in period $T-1$, absent uncertainty in period T, is given by

$$u'(C_{T-1})(1+\eta(\lambda-(\lambda-1)F_Y(Y_{T-1}))) = \beta(1+r)u'(C_T)(1+\gamma\eta(\lambda-(\lambda-1)F_Y(Y_{T-1}))). \quad (5)$$

In Equation (5), it can be seen that, iff the prospective news discount factor equals one, i.e., $\gamma = 1$, the contemporaneous and the prospective marginal news utility cancel each other out. However, iff $\gamma < 1$, the agent reduces the weight on the future utility relative to the present utility by a factor of $\frac{1+\gamma\eta\lambda}{1+\eta\lambda} < \frac{1+\gamma\eta}{1+\eta} < 1$. After retirement, the news-utility agent follows the standard agent's consumption path if the prospective news discount factor γ is sufficiently high, and otherwise follows a hyperbolic agent's consumption path with discount factor $b = \frac{1+\gamma\eta\lambda}{1+\eta}$. Because $\min\{\frac{1+\gamma\eta\lambda}{1+\eta}, 1\} > \frac{1+\gamma\eta}{1+\eta}$ iff $\gamma < 1$, the agent's factor for reducing the weight on future utility is necessarily lower in the period just before retirement than afterward, which implies that consumption drops at retirement. This drop is brought about by a change in the agent's effective time-inconsistency problem, which is necessary for observing a drop in consumption at the same time as an increase in savings.

We now move on to a fully-fledged, life-cycle model to assess whether the model's quantitative predictions about the drop in consumption at retirement roughly match the empirical evidence. We also assess whether the models can generate a simultaneous increase in savings.

We choose the model environment in line with the life-cycle consumption literature and present the numerical results of a power-utility model; that is, $u(C) = \frac{C^{1-\theta}}{1-\theta}$, with θ being the coefficient of constant relative risk aversion. We follow Carroll (1997) and Gourinchas and Parker (2002), who specify income Y_t as log-normal and characterized by deterministic permanent income growth G_t, permanent shocks N_t^P, and transitory shocks N_t^T, which allow for a low probability p of unemployment or illness

$$Y_t = P_t N_t^T = P_{t-1} G_t N_t^P N_t^T$$

$$N_t^T = \begin{cases} e^{s_t^T} & \text{with probability } 1-p \text{ and } s_t^T \sim N(\mu_T, \sigma_T^2) \\ 0 & \text{with probability } p \end{cases} \quad N_t^P = e^{s_t^P} \; s_t^P \sim N(\mu_P, \sigma_P^2).$$

Labor income is stochastic up until period $T-R$, when the agent enters retirement and his income is deterministic. The life-cycle literature suggests fairly tight ranges for the parameters of the log-normal income process, which are approximately $\mu_T = \mu_P = 0$, $\sigma_T = \sigma_P = 0.1$, and $p = 0.01$. The deterministic profile G_t is estimated from the CEX data.[16] The agent has access to a simple savings account that pays net interest $r = 0.01$. For the preference parameters, we use calibrations that are standard in the literature, as displayed in Table C.5 and discussed by Pagel (2017) among others.

[16]Following Gourinchas and Parker (2002), we choose age 25 as the beginning of working life and then $\hat{Ret} = 11$ years of retirement and $\hat{T} = 78$ in accordance with the average retirement age in the US according to the OECD and the average life expectancy in the US according to the United Nations (UN).

Table C.5: Environmental and Preference Parameters

parameter	μ_P	σ_P	μ_T	σ_T	p	G_t	r	P_0	$\frac{A_0}{P_0}$	R	T
value	0	0.1	0	0.1	0.01	$\widehat{G_t}$	0.01	1	0.0096	11	78

parameter	β	θ	η	λ	γ	b	τ
value	0.97	2	1	2	0.7	0.7	0.1

This table displays all calibrated parameters.

The model cannot be solved analytically, but it can be solved by numerical backward induction (see Gourinchas and Parker, 2002; Carroll, 2001, among others). We now illustrate the numerical solution in greater detail.

Derivation of the news-utility model We now outline the second-to-last period for the case of power utility. In the second-to-last period the agent allocates his cash-on-hand X_{T-1} between contemporaneous consumption C_{T-1} and future consumption C_T, knowing that in the last period he will consume whatever he saved in addition to last period's income shock $C_T = X_T = (X_{T-1} - C_{T-1})R + Y_T$. According to the monotone-personal equilibrium solution concept, in period $T-1$ the agent takes the beliefs about contemporaneous and future consumption he entered the period with $\{F^{T-2}_{C_{T-1}}, F^{T-2}_{C_T}\}$ as given and maximizes

$$u(C_{T-1}) + n(C_{T-1}, F^{T-2}_{C_{T-1}}) + \gamma\beta\boldsymbol{n}(F^{T-1,T-2}_{C_T}) + \beta E_{T-1}[u(C_T) + n(C_T, F^{T-1}_{C_T})]$$

which can be rewritten as

$$u(C_{T-1}) + \eta\int_{-\infty}^{C_{T-1}} (u(C_{T-1}) - u(c))dF^{T-2}_{C_{T-1}}(c) + \eta\lambda\int_{C_{T-1}}^{\infty} (u(C_{T-1}) - u(c))dF^{T-2}_{C_{T-1}}(c)$$

$$+\gamma\beta\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}(u(c)-u(r))dF^{T-1,T-2}_{C_T}(c,r)+\beta E_{T-1}[u(C_T)+\eta(\lambda-1)\int_{C_T}^{\infty}(u(C_T)-u(c))dF^{T-1}_{C_T}(c)].$$

To gain intuition for the model's predictions, we explain the derivation of the first-order condition

$$u'(C_{T-1})(1 + \eta(\lambda - (\lambda - 1)F^{T-2}_{C_{T-1}}(C_{T-1}))) = \gamma\beta R E_{T-1}[u'(C_T)]\eta(\lambda - (\lambda - 1)F^{T-2}_{A_{T-1}}(A_{T-1}))$$

$$+\beta R E_{T-1}[u'(C_T) + \eta(\lambda - 1)\int_{C_T}^{\infty} (u'(C_T) - u'(c))dF^{T-1}_{C_T}(c)].$$

The first two terms in the first-order condition represent the marginal consumption utility and news utility over contemporaneous consumption in period $T-1$. As the agent takes his beliefs $\{F^{T-2}_{C_{T-1}}, F^{T-2}_{C_T}\}$ as given in the optimization, we apply Leibniz's rule for differentiation under the integral sign. This results in marginal news utility being the sum of states that would have promised less consumption $F^{T-2}_{C_{T-1}}(C_{T-1})$, weighted by η, or more consumption

$1 - F^{T-2}_{C_{T-1}}(C_{T-1})$, weighted by $\eta\lambda$,

$$\frac{\partial n(C_{T-1}, F^{T-2}_{C_{T-1}})}{\partial C_{T-1}} = u'(C_{T-1})\eta(\lambda - (\lambda - 1)F^{T-2}_{C_{T-1}}(C_{T-1})).$$

Note that, if contemporaneous consumption is increasing in the realization of cash-on-hand then we can simplify $F^{T-2}_{C_{T-1}}(C_{T-1}) = F^{T-2}_{X_{T-1}}(X_{T-1})$. Returning to the maximization problem the third term represents the prospective news utility over future consumption C_T experienced in $T-1$. As before, the marginal news utility is given by the weighted sum of states $\gamma\beta R E_{T-1}[u'(C_T)]\eta(\lambda-(\lambda-1)F^{T-2}_{A_{T-1}}(A_{T-1}))$. Note that $F^{T-2}_{C_T}(c)$ is defined as the probability $Pr(C_T < c|I_{T-2})$ and

$$Pr(C_T < c|I_{T-2}) = Pr(A_{T-1}R + Y_T < c|I_{T-2}) = Pr(A_{T-1} < \frac{c - Y_T}{R}|I_{T-2}).$$

Thus, if savings and therefore future consumption are increasing in the realization of cash-on-hand, then we can simplify $F^{T-2}_{A_{T-1}}(A_{T-1}) = F^{T-2}_{X_{T-1}}(X_{T-1})$.

The last term in the maximization problem represents consumption and news utility over future consumption C_T in the last period T, i.e., the first derivative of the agent's continuation value with respect to consumption or the marginal value of savings. Expected marginal news utility $\eta(\lambda-1)\int_{C_T}^{\infty}(u'(C_T) - u'(c))dF^{T-1}_{C_T}(c)$ is positive for any concave utility function such that

$$\Psi'_{T-1} = \beta R E_{T-1}[u'(C_T)+\eta(\lambda-1)\int_{C_T}^{\infty}(u'(C_T)-u'(c))dF^{T-1}_{C_T}(c)] > \beta R E_{T-1}[u'(C_T)] = \Phi'_{T-1}.$$

The first-order condition can now be rewritten as

$$u'(C_{T-1}) = \frac{\Psi'_{T-1} + \gamma\Phi'_{T-1}\eta(\lambda - (\lambda - 1)F^{T-2}_{X_{T-1}}(X_{T-1}))}{1 + \eta(\lambda - (\lambda - 1)F^{T-2}_{X_{T-1}}(X_{T-1}))}.$$

Beyond the additional precautionary-savings motive $\Psi'_{T-1} > \Phi'_{T-1}$ implies that an increase in $F^{T-2}_{X_{T-1}}(X_{T-1})$ decreases

$$\frac{\frac{\Psi'_{T-1}}{\Phi'_{T-1}} + \gamma\eta(\lambda - (\lambda - 1)F^{T-2}_{X_{T-1}}(X_{T-1}))}{1 + \eta(\lambda - (\lambda - 1)F^{T-2}_{X_{T-1}}(X_{T-1}))}.$$

The news-utility agent's maximization problem in any period $T-i$ is given by

$$u(C_{T-i}) + n(C_{T-i}, F^{T-i-1}_{C_{T-i}}) + \gamma\sum_{\tau=1}^{i}\beta^{\tau}\boldsymbol{n}(F^{T-i,T-i-1}_{C_{T-i+\tau}}) + \sum_{\tau=1}^{i}\beta^{\tau}E_{T-i}[U(C_{T-i+\tau})].$$

Again, we can normalize maximization problem by $P^{1-\theta}_{T-i}$ because all terms are proportional to consumption utility $u(\cdot)$. In normalized terms, the news-utility agent's first-order condition in any period $T-i$ is given by

$$u'(c_{T-i}) = \frac{\Psi'_{T-i} + \gamma\Phi'_{T-i}\eta(\lambda - (\lambda - 1)F^{T-i-1}_{c_{T-i}}(c_{T-i}))}{1 + \eta(\lambda - (\lambda - 1)F^{T-i-1}_{a_{T-i}}(a_{T-i}))}$$

We solve for each optimal value of c^*_{T-i} for a grid of savings a_{T-i}, as Ψ'_{T-i} and Φ'_{T-i} are functions of a_{T-i} until we find a fixed point of c^*_{T-i}, a_{T-i}, $F^{T-i-1}_{a_{T-i}}(a_{T-i})$, and $F^{T-i-1}_{c_{T-i}}(c_{T-i})$. We can infer the latter two from the observation that each $c_{T-i} + a_{T-i} = x_{T-i}$ has a certain probability given the value of savings a_{T-i-1} we are currently iterating on. However, this probability varies with the realization of permanent income $G_{T-i}e^{s^P_{T-i}}$; thus, we cannot fully normalize the problem, but we have to find the right consumption grid for each value of $G_{T-i}e^{s^P_{T-i}}$ rather than just one. The first-order condition can be slightly modified as follows

$$u'(G_{T-i}e^{s^P_{T-i}}c_{T-i}) = \frac{(G_{T-i}e^{s^P_{T-i}})^{-\theta}\Psi'_{T-i} + \gamma(G_{T-i}e^{s^P_{T-i}})^{-\theta}\Phi'_{T-i}\eta(\lambda - (\lambda-1)F^{T-i-1}_{c_{T-i}}(c_{T-i}))}{1+\eta(\lambda-(\lambda-1)F^{T-i-1}_{a_{T-i}}(a_{T-i}))}$$

to find each corresponding grid value. Note that, the resulting two-dimensional grid for c_{T-i} will be the normalized grid for each realization of s^T_t and s^P_t, because we multiply both sides of the first-order conditions with $(G_{T-i}e^{s^P_{T-i}})^{-\theta}$. Thus, the agent's consumption utility continuation value is

$$\Phi'_{T-i-1} = \beta R E_{T-i-1}[\frac{\partial c_{T-i}}{\partial x_{T-i}}(G_{T-i}e^{S^P_{T-i}})^{-\theta}u'(c_{T-i}) + (1-\frac{\partial c_{T-i}}{\partial x_{T-i}})(G_{T-i}e^{S^P_{T-i}})^{-\theta}\Phi'_{T-i}].$$

The agent's news-utility continuation value is given by

$$P^{-\theta}_{T-i-1}\Psi'_{T-i-1} = \beta R E_{T-i-1}[\frac{dC_{T-i}}{dX_{T-i}}u'(C_{T-i})$$

$$+\eta(\lambda-1)\int\limits_{C_{T-i}<C^{T-i-1}_{T-i}}(\frac{dC_{T-i}}{dX_{T-i}}u'(C_{T-i}) - x)dF^{T-i-1}_{\frac{dC_{T-i}}{dX_{T-i}}u'(C_{T-i})}(x)$$

$$+\gamma\eta(\lambda-1)\int\limits_{A_{T-i}<A^{T-i-1}_{T-i}}(\frac{dA_{T-i}}{dX_{T-i}}P^{-\theta}_{T-i}\Phi'_{T-i} - x)dF^{T-i-1}_{\frac{dA_{T-i}}{dX_{T-i}}P^{-\theta}_{T-i}\Phi'_{T-i}}(x) + (1-\frac{dC_{T-i}}{dX_{T-i}})P^{-\theta}_{T-i}\Psi'_{T-i}]$$

(here, $\int\limits_{C_{T-i}<C^{T-i-1}_{T-i}}$ means the integral over the loss domain) or in normalized terms

$$\Psi'_{T-i-1} = \beta R E_{T-i-1}[\frac{dc_{T-i}}{dx_{T-i}}u'(c_{T-i})(G_{T-i}e^{s^P_{T-i}})^{-\theta}$$

$$+\eta(\lambda-1)\int\limits_{C_{T-i}<C^{T-i-1}_{T-i}}(\frac{dc_{T-i}}{dx_{T-i}}u'(c_{T-i})(G_{T-i}e^{S^P_{T-i}})^{-\theta} - x)dF^{T-i-1}_{\frac{dc_{T-i}}{dx_{T-i}}u'(c_{T-i})(G_{T-i}e^{S^P_{T-i}})^{-\theta}}(x)$$

$$+\gamma\eta(\lambda-1)\int\limits_{A_{T-i}<A^{T-i-1}_{T-i}}(\frac{da_{T-i}}{dx_{T-i}}\Phi'_{T-i}(G_{T-i}e^{S^P_{T-i}})^{-\theta}-x)dF^{T-i-1}_{\frac{da_{T-i}}{dx_{T-i}}\Phi'_{T-i}(G_{T-i}e^{S^P_{T-i}})^{-\theta}}(x)+(1-\frac{dc_{T-i}}{dx_{T-i}})(G_{T-i}e^{S^P_{T-i}})^{-\theta}\Psi'_{T-i}].$$

Derivation of the hyperbolic-discounting model We consider an agent with hyperbolic-discounting preferences with the hyperbolic-discounting parameter denoted by γ. The agent's maximization problem in any period $T-i$ is

$$max\{u(C_{T-i})+\gamma\sum_{\tau=1}^{i}\beta^{\tau}E_{T-i}[u(C_{T-i+\tau})]\}.$$

We can normalize the maximization problem by $P_{T-i}^{1-\theta}$ as for the standard agent. We can solve the model by numerical backward induction (as Laibson et al. (2012)) and the first-order condition is

$$u'(c_{T-i})=\gamma\Phi'_{T-i}=\gamma\beta RE_{T-i}[\frac{\partial c_{T-i+\tau}}{\partial x_{T-i+1}}(G_{T-i+1}e^{s^P_{T-i+1}})^{-\theta}u'(c_{T-i+1})$$

$$+(1-\frac{\partial c_{T-i+1}}{\partial x_{T-i+1}})(G_{T-i+1}e^{s^P_{T-i+1}})^{-\theta}\Phi'_{T-i+1}].$$

Derivation of the temptation-disutility model Consider an agent with temptation-disutility preferences as developed by Gul and Pesendorfer (2004) following the specification of Bucciol (2012). The "tempted" agent's lifetime utility is given by

$$u(C_t)-\lambda^{td}(u(\tilde{C}_t)-u(C_t))+E_t[\sum_{\tau=1}^{T-t}\beta^{\tau}(u(C_{t+\tau})-\lambda^{td}(u(\tilde{C}_{t+\tau})-u(C_{t+\tau})))]$$

with $\tilde{C}_t$ being the most tempting alternative consumption level and $\lambda^{td}\in[0,\infty)$. Note that, in a life-cycle model context, the most tempting alternative is to consume the entire cash-on-hand but not more. This is because borrowing could be infinitely painful with power utility and a chance of zero income in all future periods. For illustration, in the second-to-last period the agent's maximization problem is

$$u(C_{T-1})-\lambda^{td}(u(X_{T-1})-u(C_{T-1}))+\beta E_{T-1}[u(R(X_{T-1}-C_{T-1})+Y_T)]$$

which can be normalized by $P_{T-1}^{(1-\theta)}$ (then $C_T=P_Tc_T$ for instance) and the maximization problem becomes

$$(P_{T-1})^{1-\theta}(u(c_{T-1})-\lambda^{td}(u(x_{T-1})-u(c_{T-1})))+(P_{T-1})^{1-\theta}\beta E_{T-1}[(G_Te^{s^P_T})^{1-\theta}u(\frac{R}{G_Te^{s^P_T}}(x_{T-1}-c_{T-1})+y_T)]$$

which results in the following first-order condition

$$u'(c_{T-1})=\frac{1}{1+\lambda^{td}}\beta E_{T-1}[(G_Te^{s^P_T})^{-\theta}Ru'(\frac{R}{G_Te^{s^P_T}}(x_{T-1}-c_{T-1})+y_T)]$$

with Φ'_{T-1} being a function of savings $x_{T-1}-c_{T-1}$. The first-order condition can be solved very robustly by iterating on a grid of savings a_{T-1} assuming $c^*_{T-1}=(\Phi'_{T-1})^{-\frac{1}{\theta}}=(f^{\Phi'}(a_{T-1}))^{-\frac{1}{\theta}}$. The normalized agent's first-order condition in any period $T-i$ is given by

$$c_{T-i}^{-\theta}=\frac{1}{1+\lambda^{td}}\beta E_{T-i}[(G_{T-i+1}e^{s^P_{T-i+1}})^{-\theta}R\frac{dc_{T-i+1}}{dx_{T-i+1}}u'(c_{T-i+1})]$$

$$+(1-\frac{dc_{T-i+1}}{dx_{T-i+1}})(G_{T-i+1}e^{S^P_{T-i+1}})^{-\theta}\Phi'_{T-1}].$$

D Replicating the Analysis in Other Data Sets

CEX data

We use data from the CEX for 1980 to 2002. Following Aguiar and Hurst (2013), we use the National Bureau of Economic Research (NBER) extraction files by John Sabelhaus and Ed Harris of the US Congressional Budget Office. The data set links four quarterly interviews for each respondent household and collapses all the spending, income, and account balances categories into a consistent set of categories covering all the years. The CEX is conducted by the US Bureau of Labor Statistics and surveys a large sample of the US population to collect data on consumption expenditures, demographics, income, and assets. Following Harris and Sebelhaus (2000), consumption expenditures include food, tobacco, alcohol, amusement, clothing, personal care, housing, housing operations (e.g., furniture and house supplies), personal business, transportation (e.g., autos and gas), recreational activities (such as books and sports), and charity expenditures. Alternatively, we could consider non-durable or discretionary consumption only. Income consists of wages, business income, farm income, rents, dividends, interest, pension, social security, supplemental security, unemployment benefits, worker's compensation, public assistance, food stamps, and scholarships. As in the Icelandic data, we call all incoming payments income even if they may be dissaving. Retirement status is available and defined as a binary variable. Moreover, for part of the sample, balances in checking and savings accounts are available.

In addition to the retirement and age effects of interest, the data are contaminated by potential time and cohort effects, which constitutes an identification problem because time minus age equals cohort. In the portfolio-choice literature, it is standard practice to solve the identification problem by acknowledging age and time effects (as tradable and non-tradable income varies with age, and contemporaneous stock market happenings are likely to affect participation and shares) while omitting cohort effects (Campbell and Viceira, 2002). By contrast, in the consumption literature it is standard to omit time effects but acknowledge cohort effects (Gourinchas and Parker, 2002). By including the full set of fixed effects, we identify the regression simply by an arbitrary trend assumption (we find the same results when omitting the year fixed effects while including the region's unemployment rate, following Gourinchas and Parker (2002)). Instead of age dummies, we can use a polynomial in age to the fifth power, and we can control for family size and number of earners in the same way.

SCF data

The SCF is a statistical survey of income, balance sheets, pensions, and other demographic characteristics of families in the United States, sponsored by the Federal Reserve Board in cooperation with the Treasury Department. We use the data from six waves from 1992 to 2007. However, as in the case of the CEX data, the SCF does not survey households consecutively, and therefore, we cannot employ household fixed effects. As before, we estimate the effect of retirement jointly controlling for age, time, and cohort fixed effects and identify the model with a random assumption about its trend. We control for family size in the same manner as in the CEX data. Retirement status is also defined as a binary variable in the SCF, and we also have information on balances in savings accounts. Income is again using all inflows whether from labor, pensions, or businesses. Furthermore, we consider all debt, i.e., the sum of consumer, education, and mortgage debt, and leverage, debt divided by total household assets, such as account balances, stocks, bonds, funds, and durables (e.g., cars and houses). Again, we log all outcome variables.

Consumption surveys such as the CEX and SCF use paper or phone interviews to ask stylized questions on spending and financial standing in consumption good categories over a particular recall period or households are asked to keep track of recurrent expenditures, such as groceries, for a short period of time in a diary. Measurement error arises because survey respondents may have difficulties recalling past purchases and have little incentive to answer the questions accurately. For instance, respondents may not understand the wording of the questions, may behave differently in practice, may simply forget some past purchase transactions, or may strategically underreport consumption to avoid more detailed follow-up questions (Parker and Souleles, 2017). Moreover, such measurement error or noise in the data generated by surveys that simply ask about past purchases can increase with the length of the recall period (de Nicola and Giné, 2014). Additionally, surveys can produce data with systematic biases if respondents have justification bias, concerns about surveyors sharing the information, or stigma about their consumption habits (Karlan and Zinman, 2008).

German bank account data

We replicate our results in a data set that includes information on income, spending, and checking, credit, and portfolio accounts from a German bank covering approximately 5,000 individuals who transitioned into retirement in the period from 1998 to 2010.[17] Retirement status is identified by looking for federal pension payment indicators in the transaction descriptions. Furthermore, we define income as the sum of all incoming transactions and spending as the sum of all outflows out of the checking accounts ensuring that we exclude all transactions between accounts.

PSID data

The PSID is a nationally representative survey of households in the United States conducted by the University of Michigan. It was administered annually from 1968 to 1997 and then biennially after 1997. It included questions that relate to specific consumption and savings measures after 1997. Following the literature, we use the consumption and savings data post 1997 (Li et al., 2010) and consumption is measured as expenditure on food, housing, transportation, education, childcare, and healthcare. As before, we define income as the sum of household taxable income, unemployment income, unexpected income (income from insurance settlements, inheritances), and retirement income (income from retirement pay, pensions, or annuities).

HRS data

Finally, we replicate our results using the HRS conducted by the University of Michigan. This survey asks individuals and their spouses who are over 50 years old about their health, employment, quality of life, and wealth. It was conducted biennially from 1992 to 2014. In 2001, the HRS sent a consumption-and-activities mail survey (CAMS) to a subsample of the initial HRS population, and it has tracked consumption for these households biennially ever since. The RAND Center for the Study of Aging provides clean versions of each wave of HRS data, which we merged with the CAMS data set to extract information on individuals' consumption and savings. We again use all household discretionary spending categories and total household income measuring all inflows. We construct the savings variable as the sum of the values of

[17] This transaction-level data set has been obtained from a German online bank that has a brokerage arm but also a full-service retail banking arm. Beyond checking, savings, settlement, and credit account transactions, the data set contains information on all portfolio trades and holdings.

CDs, government savings bonds, checking, savings, and money market accounts, stocks, mutual funds, investment trusts, bonds, bond funds, and all other savings. The results of the HRS analysis are consistent with our previous results. When they retire, individuals consume less but increase their savings, retirement savings accounts (IRA) assets, and overall wealth. Again, we log all outcome variables.

Table D.6: The Effects of Retirement on Personal Finances using CEX data

	Income minus consumption	Income minus consumption	Current account	Checking account	Savings account	Savings account
Retired	0.203***	0.0960***	1.024***	0.957***	1.488***	1.391***
	(6.84)	(3.64)	(8.80)	(8.18)	(8.60)	(8.06)
Unemployment rate	✓	✓	✓	✓	✓	✓
# earners	✓	✓	✓	✓	✓	✓
# family	✓	✓	✓	✓	✓	✓
Cohort FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Age FE	✓	✓	✓	✓	✓	✓
Total HH income		✓		✓		✓
#obs	36,505	36,505	26,046	25,813	21,408	21,248

Note: [a] This table shows regression results for log household savings (measured as income minus spending) as well as checking and savings account balances. Standard errors are robust to heteroskedasticity. t-statistics are displayed in parentheses. [b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

Table D.7: The Effects of Retirement on Personal Finances using SCF data

	Leverage		Debt		Checking account		Savings account	
Retired	-0.293**	-0.349***	-0.674***	-0.211***	0.006	0.329***	0.076	0.407***
	(-3.02)	(-3.38)	(-15.81)	(-5.31)	(0.15)	(9.02)	(1.44)	(8.02)
# family	✓	✓	✓	✓	✓	✓	✓	✓
Cohort FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Age FE	✓	✓	✓	✓	✓	✓	✓	✓
Total HH income		✓		✓		✓		✓
#obs	128,805	128,085	99,249	98,734	119,110	118,461	58,612	58,422

Note: [a] This table shows regression results for leverage, debt, as well as checking and savings account balances. Standard errors are robust to heteroskedasticity. t-statistics are displayed in parentheses. [b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

Table D.8: The Effects of Retirement on Personal Finances using German bank data

	Income minus spending		Checking account		Value of portfolio		Credit account balance	
Retired	0.145**	0.149***	0.311***	0.0781	0.358***	0.327***	-0.152	-0.153
	(3.20)	(7.20)	(6.42)	(1.81)	(7.44)	(5.86)	(-1.82)	(-1.83)
Indiv FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓	✓	✓
Total HH income		✓		✓		✓		✓
#obs	1,407,347	1,407,347	1,407,347	1,407,347	250,664	250,664	158,173	158,173

Note: [a] This table shows regression results for log household savings (measured as income minus spending), checking account balances, portfolio, and credit account balances. Standard errors are clustered at the individual level. t-statistics are displayed in parentheses.
[b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

Table D.9: The Effects of Retirement on Personal Finances using PSID data

	Spending		Savings		Debt		Wealth	
Retired	-0.146***	-0.0958***	0.00342	0.143**	-0.310**	-0.334**	17875.9**	24945.9***
	(-9.28)	(-6.33)	(0.07)	(2.81)	(-2.98)	(-3.11)	(3.06)	(4.18)
Indiv FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Total HH income		✓		✓		✓		✓
#obs	68,895	68,240	68,895	68,240	44,442	43,989	68,895	68,240

Note: [a] This table shows regression results for log household spending, checking and savings account balances, amount of debt, and wealth (winsorized not logged due to many negative observations). Standard errors are clustered at the individual level. t-statistics are displayed in parentheses. [b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

Table D.10: The Effects of Retirement on Personal Finances using HRS data

	Spending		Savings		IRA assets		Financial wealth	
Retired	-0.240***	-0.229***	0.0814	0.234***	0.271***	0.295***	0.106	0.235***
	(-2.82)	(-2.70)	(1.10)	(3.17)	(3.79)	(4.03)	(1.45)	(3.25)
Indiv FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Total HH income		✓		✓		✓		✓
#obs	1,184	1,184	9,455	9,455	9,455	9,455	9,455	9,455

Note: [a] This table shows regression results for log household spending, savings, amount of IRA assets, and wealth. Standard errors are clustered at the individual level. t-statistics are displayed in parentheses. [b] Significance levels: * p<0.1 ** p<0.05 *** p< 0.01

E The Icelandic pension system

The Icelandic pension system consists of three pillars: a tax-financed public pension (social security benefits); compulsory occupational pension funds, which are the dominant feature of the system; and voluntary private pensions with tax incentives.

Pillar one - public pensions. The social security system in Iceland was founded in 1936 with the main purpose of ensuring the livelihood of those unable to work because of old age or disability. The system provides old age, disability, sickness, maternity, and survivors' pensions. The old age pension is paid from the age of 67. The public pension is paid as a basic pension and supplementary additions to single or low-income people. The basic pension is low, or roughly 10 percent of the average earnings of unskilled workers, and is means-tested by a 30 percent reduction rate after a certain income threshold. The main transfers are, however, paid through the supplementary pension, which is also means-tested with a 45 percent reduction rate. The maximum pension per year for an individual without any supplementary income is almost the same as the minimum wage level. The public pension system in Iceland is fully financed by taxes. The main financing source is the social security tax, which is earmarked to the social security system. The social security tax rate is currently 5.79 percent and the tax base is total salaries. The social security tax is paid by the employers.

Pillar two - occupational pensions. Occupational pensions are the cornerstone of the Icelandic pension system. The occupational pension system, making occupational pension funds available to the general public, was established in 1969 by agreement between the social partners. In 1974 it was made mandatory by law for all wage and salary earners. The compulsory employer- and employee-financed pension system provides benefits amounting to 50 percent to 60 percent of full-time earnings during employment in annuitized monthly pension payments. The contribution rate must be at least 11 percent with the employer paying 7 percent and the employee 4 percent. Premiums are fully deductible for tax purposes. The accumulated pension rights in the occupational pension funds are indexed to the consumer price index.

The contribution can be divided into two parts. The first part goes toward acquiring pension rights, which (for a 40-year period of contributions) should give a lifelong pension amounting to at least 56 percent of wages at the end of the contribution period. The second part can go toward acquiring additional pension rights, including defined contribution schemes with individual accounts. The main rule is that members can begin to withdraw old-age pensions at the age of 67. It is, however, possible to start withdrawing pension payments as early as age 65, but then with a reduced benefit, or as late as age 70 with additional benefits. In general, the benefit rule in the new public sector scheme and in the private sector is neutral toward the choice of early or late retirement. The question of whether it is beneficial to postpone benefit withdrawal until after age 67 depends on how long individuals expect to live. The system is designed so that the individual should be indifferent if he or she expects to live until he or she reaches the average life expectancy. Based on calculations from the Icelandic Pension Funds Association (https://www.lifeyrismal.is/static/files/old/Sveigjanleg_starfslok.pdf), early withdrawal pays off if individuals pass the age of 84, and late withdrawal pays off if individuals pass the age of 94. Individuals would therefore have to expect to live at least until the age of 94 if they were to benefit from postponing withdrawal of their benefits.

The pension benefits system is transparent and there exists a pension calculator online provided by the Social Insurance Agency under https://www.tr.is/reiknivel/. In the following, we provide printouts of two calculation exercises: one in which the individual retires immediately at age 67 and one in which he or she delays for 60 months until age 72. We provide below both the input pages as well as the results pages. As can be seen, the monthly pension payment then increases from a total of 252,457 ISK which equals approximately 2,525 USD to 311,235 ISK which equals approximately 3,112 USD. From working one month longer, the individual thus receives an additional (3,112-2,525)/60 = 9.78 USD in pension payments or approximately 0.5% in additional benefits.

Pillar three - voluntary individual pension savings. Employees can deduct from their taxable income a contribution to authorized individual pension schemes. Currently, the maximum taxable deduction by the employee is 4 percent. In addition, all employers have agreed in wage settlements to contribute 2 percent to those voluntary pension savings if the employee matched the amount with at least the same percentage. The total contribution can therefore be 6 percent. The voluntary pension savings cannot be distributed until the age of 60.[18]

[18] After the 2008 financial crisis, individuals were given permission to withdraw private pension savings to pay down debt. We observe all such one-time withdrawals but exclude individuals younger than age 60 in our analysis. This also implies that any lingering effects of the financial crisis, even if they affect older people differently than younger people, are captured by the inclusion of time fixed effects.

Pension Calculator 2019

Please note that the calculator does not yield binding results

Type of pension

Ellilífeyrir

With motor impairment assessment

(•) No ( ) Yes

With old-age pension and social security supplement in 2016 ?

(•) No ( ) Yes

On a disability or rehabilitation pension for taking an old-age pension

(•) No ( ) Yes

relationship status

1951 eða fyrr

Starts old age pension from TR

2018 eða seinna

Children under 18 years

Á ekki maka

at-home

Býr ein(n)

Children under 18 years

Ekkert barn

Get paid allowance

Engu barni

Accelerated old-age pension (number of months, 0-24) ?

0 months

Suspension of old-age pension (number of months, 0-60) ?

0 months

residential Percent ?

100 %

Tax card ratio at TR ?

100 %

Capital income is considered to be shared by spouses and therefore the aggregate capital income of pensioners and spouses must be stated. The calculation takes this into account and dividends are divided into halves.

Income before tax

(•) monthly ( ) annual earnings

Income, among other things, from employment, pensions and unemployment benefits ?

0 kr.

Payments from pension funds ?

0 kr.

Payments from private pension funds ?

0 kr.

Other income ?

0 kr.

Capital Gains ?

0 kr.

Local taxable benefits ?

0 kr.

Deducted pension fund contributions ?

0 kr.

Foreign basic pension ?

0 kr.

Calculate results

Pension Calculator 2019

Please note that the calculator will calculate payments based on the criteria you provide. The model is for guidance only but does not provide binding information on the final settlement of the case or the amount of payment.

breakdown

Payments from the Social Insurance Agency	in a month	in a year
Old-age pensions	248105	2977260
household	62695	752340
Holiday and December allowances	0	93555
Total:	310800	3823155

Deducted tax (1st tier)	114810	1412273
Personal Disc. (utilization of tax card 100%)	56447	677364
Total from TR after tax:	252437	3088246

Income from others	in a month	in a year
Income from employment	0	0
Payments from pension funds	0	0
Payments from private pension funds	0	0

Income from others	in a month	in a year
Other income	0	0
Local taxable benefits	0	0
Deducted pension fund contributions	0	0
Total:	0	0

Deducted tax (1st tier)	0	0
Personal Disc. (tax card utilization 0%)	0	0
Total from others after tax:	0	0

Capital Gains	in a month	in a year
Capital Gains	0	0
Deducted capital income tax 22%	0	0
Total capital income after tax:	0	0

Total revenue	in a month	in a year
Payments from the Social Insurance Agency	310800	3823155
Income from others	0	0
Capital Gains	0	0
Total revenue:	310800	3823155

Withholding tax	58363	734909
Deducted capital income tax	0	0
Installment claims on TR:	0	0

Total after-tax disposable income:	252437	3088246

The calculator does not take into account the rules for interaction with pension funds (this interaction is settled in next year's settlement, but is not paid every month). The calculation of capital income tax is based on withholding. It does not take into account the taxable income limit and is referred to in the Directorate of Internal Revenue's instructions.

Change the criteria

Pension Calculator 2019

Please note that the calculator does not yield binding results

Type of pension

Ellilífeyrir

With motor impairment assessment

(●) No ( ) Yes

With old-age pension and social security supplement in 2016 ?

(●) No ( ) Yes

On a disability or rehabilitation pension for taking an old-age pension

(●) No ( ) Yes

relationship status

1951 eða fyrr

Starts old age pension from TR

2017 eða fyrr

Children under 18 years

Á ekki maka

at-home

Býr ein(n)

Children under 18 years

Ekkert barn

Get paid allowance

Engu barni

Accelerated old-age pension (number of months, 0-24) ?

0 months

Suspension of old-age pension (number of months, 0-60) ?

60 months

residential Percent ?

100 %

Tax card ratio at TR ?

100 %

Capital income is considered to be shared by spouses and therefore the aggregate capital income of pensioners and spouses must be stated. The calculation takes this into account and dividends are divided into halves.

Income before tax

(●) monthly ( ) annual earnings

Income, among other things, from employment, pensions and unemployment benefits ?

0 kr.

Payments from pension funds ?

0 kr.

Payments from private pension funds ?

0 kr.

Other income ?

0 kr.

Capital Gains ?

0 kr.

Local taxable benefits ?

0 kr.

Deducted pension fund contributions ?

0 kr.

Foreign basic pension ?

0 kr.

Calculate results

Pension Calculator 2019

Please note that the calculator will calculate payments based on the criteria you provide. The model is for guidance only but does not provide binding information on the final settlement of the case or the amount of payment.

breakdown

Payments from the Social Insurance Agency	in a month	in a year
Old-age pensions	322537	3870444
household	81504	978048
Holiday and December allowances	0	121622
Total:	404041	4970114

Deducted tax (1st tier)	149253	1835960
Personal Disc. (utilization of tax card 100%)	56447	677364
Total from TR after tax:	311235	3811518

Income from others	in a month	in a year
Income from employment	0	0
Payments from pension funds	0	0
Payments from private pension funds	0	0

Income from others	in a month	in a year
Other income	0	0
Local taxable benefits	0	0
Deducted pension fund contributions	0	0
Total:	0	0

Deducted tax (1st tier)	0	0
Personal Disc. (tax card utilization 0%)	0	0
Total from others after tax:	0	0

Capital Gains	in a month	in a year
Capital Gains	0	0
Deducted capital income tax 22%	0	0
Total capital income after tax:	0	0

Total revenue	in a month	in a year
Payments from the Social Insurance Agency	404041	4970114
Income from others	0	0
Capital Gains	0	0
Total revenue:	404041	4970114

Withholding tax	92806	1158596
Deducted capital income tax	0	0
Installment claims on TR:	0	0

Total after-tax disposable income:	311235	3811518

The calculator does not take into account the rules for interaction with pension funds (this interaction is settled in next year's settlement, but is not paid every month). The calculation of capital income tax is based on withholding. It does not take into account the taxable income limit and is referred to in the Directorate of Internal Revenue's instructions.

Change the criteria