Responses to Saving Commitments: Evidence from Mortgage Run-offs

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Abstract

We study how individuals respond to the removal of a saving constraint. Mortgage run-offs predictably relax a saving constraint for borrowers who chose mortgage contracts that committed them to effectively save by paying down mortgage principal. Using the universe the Danish populations we identify individuals whose mortgages were on track to run off between 1995 and 2014. We use mortgage runoffs to understand the importance of relaxing a saving constraint on wealth, leisure, consumption, saving, and investment decisions – as well as the mechanism individuals use to circumvent the saving constraint. We find that on average, borrowers use 39 percent of the resources previously devoted to mortgage payments to decrease labor income, and use 53 percent to pay down other debts. The labor supply response is limited to those without substantial assets or debts prior to the run-off, while the debt reduction response is limited to (and one-for-one among) those without substantial assets but with other debt prior to the run-off. We find no statistically significant results for wealth accumulation in bank deposits, stocks, or bonds.

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1. Introduction

Compulsory saving schemes potentially force many households to save more, and spend less, than they would have preferred. Employer and government pension programs are an example of such compulsory savings constraint. Similarly, for some individuals mortgages potentially act as a self-imposed saving commitment. Mortgage borrowers effectively save in housing equity by making principal payments to reduce their mortgage debt, and borrowers typically choose mortgage contracts, which commit them to a predetermined schedule of such payments.

Mortgage run-offs provide an ideal natural experiment to identify the consequences of relaxing a self-imposed saving commitment. Mortgages run off when borrowers complete their schedule of payments and bring their mortgages balance to zero without prepayment. After a run-off, borrowers are no longer forced to save by paying down their mortgages; they can allocate freed-up resources to saving elsewhere, spending more, or increase leisure by working less. Because unconstrained borrowers can offset saving commitments by borrowing or saving less elsewhere, savings commitments should only affect those for whom the mortgage contract constrains saving and consumption decisions.

The consumption and investment response to a mortgage run-off can be seen as a test of a theoretically interesting variant of the Permanent Income Hypothesis, PIH henceforth (Modigliani and Brumberg, 1954; Friedman, 1957). The traditional PIH implies that unconstrained, rational, forward-looking, risk-averse individuals should not change their consumption in response to a predictable change in income. Individuals who anticipate that their income will increase in the future should draw down savings to increase consumption today, so that consumption will not increase when income does. A mortgage run-off has the same consumption-smoothing prediction: rational, unconstrained borrowers should not change consumption after the run-off. However, in the case of the run-off, this smoothing is achieved by substituting saving through mortgage principal payments for another form of savings. Since no action is required in advance, borrowers' response to the run-off – unlike their response to an income change in traditional PIH tests – should not depend on whether or not they anticipate it. While traditional tests of the PIH is a joint test of whether individuals correctly anticipate an event - and whether they smooth consumption around that event as theory would predict, our consumption-smoothing hypothesis for unconstrained borrowers does not make assumptions about the degree to which the run-off is anticipated.

There have been countless empirical tests of the PIH[2] and the failure of the PIH is often attributed to a liquidity constraint which prevents individuals from borrowing to smooth consumption (Deaton, 1991; Carroll, 1997). It thus seems likely that the effect of a mortgage run-off on consumption (in the form of goods or leisure), asset accumulation and other debt repayment should vary with the financial position of the borrower. On one hand, the mortgage repayment schedule does not impose a constraint on the saving rate or consumption of individuals that choose to save elsewhere while paying down their mortgage. These individuals could save less elsewhere to offset the saving commitment imposed by the mortgage and they could always liquidate some of their savings to finance consumption if they wanted to increase it. On the other hand, individuals who do not wish to save as much as the mortgage contract requires must choose to either consume less or borrow elsewhere at higher rates. Individuals who chose to consume less in response to the mortgage's saving commitment would be expected to spend some of the resources freed up by the run-off, either on leisure (working less) or consumption. Individuals that had financed consumption using other debt prior to the run-off would be expected to use resources freed up by the run-off to pay down other debt one-for-one after the run-off; these individuals would not be expected to adjust consumption.

This paper investigates these predictions empirically by examining the evolution of the labor supply and of the main components of households' balance sheet in the years before and after mortgage run-offs. The data used in our analysis include year-end information on the universe of the Danish population at the level of (nearly all) assets and liabilities – including those in bank accounts, investments, credit cards, mortgages, and homes – as well as employment status, pension contributions and payouts, and labor income. This allows us to examine many margins of adjustments in response to relaxing such constraints.

We test the hypothesis that borrowers reduce their labor supply and increase their savings (or reduce debt) after the run-off. We find that the liquidity freed up from mortgage payments ceasing leads to two observable adjustments. First, we confirm that just after run-offs borrowers reduce their labor supply – either by working less or retiring outright: our point estimates suggest that individuals reduce labor income by 39 percent of the amount previously devoted to mortgage payments. Second,

[2] Agarwal, Liu, and Souleles (2007), Agarwal and Qian (2014), Souleles (1999), Johnson, Parker, and Souleles (2006), and Hsieh (2003) are examples of papers that look at the consumption response to changes to income or cash on hand. Jappelli and Pistaferri (2010) survey theoretical results on the consumption response to income shocks, and Attanasio and Weber (2010) and Fuchs-Schuendeln and Hassan (2015) survey empirical results.

we find a faster repayment of other debts after the mortgage is repaid: individuals devote 53 percent of this amount to reducing other debt. However, probably because most Danes save less in taxable or investments accounts relative to other countries, we find no statistically significant evidence of asset accumulation in bank deposits, stocks, or bonds. Danes are already subjected to compulsory savings scheme which means that most of them are already at a "corner solution" in terms of savings. Chetty et al. (2013) estimate that a $1 tax subsidy to pension savings only raises $0.01 of additional pension savings by the Danish population - using virtually the same sample period – and that overall savings rates are driven by compulsory set savings levels, indicating that Danes are already at the pension saving limit.

Our results differ across sub-samples in ways that line up our theoretical intuition about how individuals in various financial positions should respond to a run-off. We find no statistically significant results among borrowers with pre-run-off assets, as these borrowers are few in number and swings in their other assets add noise that swamps our results. For borrowers without pre-run-off assets or other debt – for whom we would expect the savings constraint imposed by the mortgage to bind – labor income falls by 47 percent of freed up liquidity after the run-off. Borrowers had presumably been constrained to consume less leisure (and presumably fewer goods and services, though we cannot measure this directly) than they would have preferred prior to the run-off, and the run-off relaxed this constraint and increased leisure consumption. For these borrowers, we find no statistically significant change in other debts or assets. For borrowers without pre-runoff assets but with pre-run-off other debt, there is no evidence of a reduction in labor income. While leisure consumption does not fall after the run-off for these borrowers, we cannot reject the hypothesis that they use nearly all of the resources previously devoted to mortgage payments to paying down these other debts.

While the institutional setting of mortgage run-off on fixed rate mortgages will be familiar to U.S. readers, the data environment is much richer. We use administrative registry data from the Danish tax authorities covering the universe of Danes' mortgages. We do not observe the mortgage terms explicitly, so we identify mortgage run-off as a mortgage with a balance that falls steadily to zero; given the cost of prepayment, this will not reflect an individual consistently making larger-than-required payments each month.[3] Nearly all mortgages that have run off in recent years were standard, 20- or 30-year fixed rate mortgages with 240 or 360 monthly payments of equal size. These

[3] In our data, we do not observe the mortgage balance. Rather, we observe the value of the component of the mortgage backed security attributable to that mortgage. This value represents the mortgage balance, adjusted for the gap between the interest rate on the mortgage and the current market interest rate for mortgages with that maturity. We have data on mortgage-backed security prices to infer the mortgage balances from these data. These calculations can be made more precise using data on the annual mortgage interest paid.

mortgages differ from their counterparts in the U.S.A. in that they typically come with a prepayment penalty and are not discharged in foreclosure; these features imply that it is almost never optimal for borrowers to default or prepay in the years leading up to mortgage run-off when the mortgage balance is relatively low. Although more flexible mortgages have been available in Denmark in recent years, such mortgages are a decade or more from run-off.

This is not the first paper to consider runoffs. Coulibaly and Li (2006) and Stephens (2008) examine the run off of mortgages and auto loans, respectively, using data from the Consumer Expenditure Survey (CEX). While our final sample includes 15,895 run-offs, the small size of the CEX limits the number of run offs in these papers to 286 and about 200[4], respectively. While our data include exact wealth holdings collected by the government for taxation purposes, the CEX relies on individuals' self-reported wealth holdings. d'Astous (2016) considers the run off of a consumer term loan using administrative data from a North American financial institution. Similarly, Scholnick (2013) examines mortgage run-offs using data from a Canadian financial institution on credit cards and mortgages. In these cases, data are limited to information on one or two credit products offered by one financial institution; there is no way to observe substitution into other assets.

2. Theoretical Framework

Mortgages can be seen as saving commitments that tie a considerable portion of households' disposable income to savings in the form of mortgage payments. If we think of a mortgage as a negative bond – as a bond that a homeowner sells to investors – then paying down mortgage principal reduces the holding of this negative bond. The mortgage repayment schedule therefore imposes to borrowers a saving commitment in this bond-like asset.

We use this setting to make predictions about how a rational, forward-looking, risk-averse individual would respond when a saving commitment is relaxed in a *predictable* manner. Our theoretical framework borrows from elements of the literature on the Permanent Income Hypothesis, PIH henceforth (Modigliani and Brumberg, 1954; Friedman, 1957), and of the literature on liquidity, saving, and borrowing constraints (e.g, Zeldes, 1984; Carroll, 2001; Dau-Schmidt, 1997; Epper, 2016; Meier and Sprenger, 2010; Holden Shiferaw, and Wik, 1998; Pender, 1996).

There is an important distinction between our setting and usual tests of the PIH. The standard PIH predicts that unconstrained individuals should adjust consumption and saving prior to predictable changes in resource flows in order to smooth consumption. Because future resource flows (such as changes in income) might not always be fully anticipated by individuals, the PIH is a *joint* hypothesis

[4] About 4% of an original sample of 5,000 according to Table 1 presented in the paper.

that an individual rationally anticipates the change *and* adjusts consumption correctly given that anticipation. By contrast, we consider a predictable change in a saving requirement (the mortgage run-off), not in resource flows. In this context, unconstrained individuals should not adjust consumption in response to this change but instead are predicted to substitute one form of saving (paying down a mortgage) for another (paying down other debt or saving more) once the saving constraint is relaxed. This substitution from one form of saving to another would be predicted by standard economic models whether or not the change was anticipated.

For rationally anticipated income changes, the failure of the PIH is often attributed to a liquidity constraint which prevents individuals from borrowing to smooth consumption (Deaton, 1991; Carroll, 1997). Similarly, the response of consumers to relaxing a saving constraint should also depend on one's financial position. Consumers who were saving elsewhere in the years leading to the mortgage run-off are not constrained as they could have chosen to save less elsewhere in order to increase consumption. For such individuals, a PIH-type of model would predict that saving will increase in other accounts one-for-one with the reduced mortgage payments once it runs out. Consumers who were constrained by the saving rate imposed by their mortgage can choose to borrow to fund consumption or not. For individuals who chose not to increase consumption early, we would predict that relaxing a saving constraint would lead to an increase in consumption (or an increase in leisure). For constrained consumers who had chosen to finance consumption through other debt prior to the mortgage run-off, we would predict that they would use the freed-up liquidity from mortgage payments to pay down their other accumulated debts.

[INSERT TABLE 1 ABOUT HERE]

Table 1 summarizes how individuals are predicted to behave in response to a change in income or in saving commitments in simple standard PIH model. The first row of this table shows the prediction when an individual's resource flow (e.g., income) changes. The second row shows the predictions when a saving commitment is removed and the individual has no borrowing constraints. Finally, the third row shows the predictions when a saving commitment is removed and the individual has borrowing constraints. Importantly, for both anticipated and unanticipated changes in saving commitments, unconstrained individuals are predicted not to change consumption. Conversely, constrained individuals are predicted to increase consumption in response to the removal of a saving commitment whether they anticipated it or not.

Mortgage run-offs are such predictable and important landmarks in people's life cycle that most individuals should be able to correctly anticipate them, and time their economic choice according to the mortgage run-off date. However, our approach has the strength that our predictions of the effects of mortgage run-off on behavior do not depend on whether individuals are able or not to anticipate that the mortgage run-off is coming to an end.

Previous studies have focused on highly predictable income changes such as UI exhaustion (e.g. Ganong and Noel, 2016) or tax rebates (e.g. Agarwal et al., 2007) to study theories of consumption. These studies are effectively making a joint test of anticipation ability and rational behavior. It is interesting in its own right to study and tease apart these two. However, since our predictions are independent of whether the individual is able or not to anticipate the change, we are making a barebones test of rationality of what people do when they don't have to commit part of their income to pay for their mortgage. Even inattentive individuals that do not realize that their mortgage is coming to an end should respond according to our predictions. Therefore, our rationality test focuses on consumption, saving and borrowing choices and does not require perfect foresight and anticipation of the discontinuous change in freed up resources that other papers study.

3. Data

a. Data sources

Our dataset includes demographic, economic, and educational information on the universe of adult Danes between 1986 and 2014. We derive data from two different administrative registers made available through Statistics Denmark: demographic information from the Danish Civil Registration System (*CPR Registeret*), and income and financial information from the Danish Tax Authority (SKAT).

Demographic information from the official Danish Civil Registration System (CPR Registeret) include the individual's personal identification number (CPR) as well as their gender, date of birth, and the individual's marital history (number of marriages, divorces, and history of spousal bereavement). The CPR number is unique for each individual in the population, and this number is used as the unique individual identification number across all administrative datasets. The administrative record also contains a unique household identification number, as well as CPR numbers of each individual's spouse and any children in the household. We use these data to obtain basic demographical information about each individual and household. The sample contains the entire Danish population and provides a unique identifying number across individuals, households, and time.

Income and financial information from the Danish Tax Authority (SKAT) contains both the total and disaggregated income and wealth information by CPR numbers for the entire Danish population. SKAT receives this information directly from the relevant third-party sources, because employers supply statements of wages paid to their employees, and all financial institutions supply information to SKAT on their customers' deposits, interest paid (or received), security investments, and dividends. Because taxation in Denmark mainly occurs at the source level, the income and wealth information are highly reliable. For our purpose here, the records include the total outstanding mortgages at the end of the year, as well as the total interest payments paid on the mortgage within the year. Though SKAT information is extensive, not all components of wealth are recorded by SKAT. The Danish Tax Authority does not have information about individuals' holdings of unbanked cash, the value of their cars, their private debt (i.e., debt to private individuals), accumulated pension savings, private businesses, or other informal wealth holdings.

b. Methodology

The mortgage run-offs we consider inherit the appealing econometric features of a regression discontinuity design (RDD) or regression kink design (RKD) (Lee and Lemieux, 2010). Mortgage run-offs remove a savings constraint; a borrowers' cash available jumps discontinuously when the mortgage runs off at a pre-specified time (Coulibaly and Li, 2006; Scholnick, 2013). The timing of this discontinuity is determined 20 or 30 years before when the mortgage is originated. We then examine the evolution of wealth from year_{t-3} to year_{t+3}.

These RDD and RKD techniques were originally used by Thistlethwaite and Campbell (1960) to study the impact of merit awards on future academic outcomes, and has been recently applied to Norwegian register data by Kirkeboen et al. (2016) to study the impact of type and quality of education on income later in life. These methodologies rely on the assumption that individuals are unable to precisely manipulate their position around the discontinuity and effectively replicate a randomized experiment in which individuals would be randomly assigned to the treatment. In our case, because borrowers have committed to their mortgage repayment schedule many years ago, the actual date of their final payment can be considered quasi-exogenous to their financial condition in the years surrounding the run-off. As a practical matter, our annual data make high frequency analysis before and after the run-off difficult, since the run-off event can happen at any time of the year. Instead, our primary analysis focuses on a comparison of economic outcomes in the years before versus after the run-off.

However, because the mortgage could be refinanced (or prepaid, although at a cost), unobservable variables could correlate with the decision to *refinance* the mortgage and with other outcomes studied in the analysis. To overcome the fact that prepayment could create a selection problem, we look at mortgages whose balances appear on track to run off at year t based on changes in balances in year_{t-6} to year_{t-3}. The main analysis therefore uses the *anticipated* date of final payment — predicted three years before its realization — as the event relaxing the saving commitment. In this intention-to-treat (ITT) approach (e.g. Imbens and Rudin, 2015), random assignment into the treatment is assumed to hold for the predicted final payment date, not its actual realization. This *intent-to-treat* approach looks at mortgages on the glide path to run off, whether they actually run off or not. This allows us to observe households who take out a new mortgage just when their old mortgage is running out so that their total mortgage balance never falls to zero. This also mitigates concerns about unobservable variables correlating with the final payment and subsequent behavior, while still capturing a discontinuous change in annual required mortgage payments.

c. Sample Construction

We do not have the exact terms of the mortgages, and use the balance at the end of each calendar year to identify expected run-off year and the estimated annual payment. We identify a mortgage as on track to run off in exactly three years if the following criteria are met: (i) The cumulative decline in the mortgage balance over the past three years (between six and three years before the expected run-off) must be similar to – between 80% and 120% of – the mortgage balance (three years before the expected run-off); and, (ii) The annual declines in the mortgage balance over the past three years (between six and five years, five and four years, and four and three years before the expected run-off) must be similar to – between 75% and 133% of – one another;[5]

Using this approach, we identity 77,790 individuals in the sample with an expected run-off year between 2001 and 2011. Since we examine behavior in the three years before and after an expected run-off, the analysis includes data from 1998 (three years before the first expected run-off in the sample) to 2014 (three years after the last expected run-off in the sample). We define the estimated annual mortgage payment as one third of the balance three years prior to the expected run-off. We additionally impose three restrictions on the sample, where either identification of outcome variables are diffuse due to limits in the registerdata, or where identification of treatment is diffuse very small run-offs.[6]

[5] $0.75 \leq \frac{Bal_6 - Bal_5}{Bal_5 - Bal_4} \leq 1.33$ and $0.75 \leq \frac{Bal_5 - Bal_4}{Bal_4 - Bal_3} \leq 1.33$

[6] The three restrictions are: (i) 17,111 individuals (22 percent of our initial sample) who receive any small income from privately owned companies (ii) 1,043 individuals (1.3 percent of our initial sample) with either large (>1 million DKK) year-to-year changes in net financial wealth or extremely large (>10 million DKK) housing wealth; (iii); 55,301 individuals (71 percent of our initial sample) with small mortgage payments relative to their income (estimated annual mortgage payments less than 10 percent of average of annual labor income between five and three years before the expected run-off). We exclude these small mortgages from our baseline analysis to focus on mortgages that are economically significant to borrowers. Additional robustness checks in Section 5 exploit these small mortgages to perform a placebo test.

After imposing these restrictions, our final sample consists of 15,895 individuals.[7] These individuals show mortgage balances that fall mechanically between six and three years prior to the expected run-off year (Figure 1). The median mortgage balance falls to zero in the expected run-off year (Figure 1 (a)) and the share of mortgages with zero balance jumps discontinuously from less than 20 percent in the year prior to the expected run-off to more than 50 percent in the year of the expected run-off (Figure 1 (b)).

[INSERT FIGURE 1 ABOUT HERE]

Table 2 presents descriptive statistics for the sample used in the analysis. All variables are recorded at the end of the calendar year and are measured three years prior to the year in which the mortgage is paid off. All monetary amounts are expressed in Danish kroner (DKK).[8] *Panel A* shows that our sample consists of individuals who are on average 57 years old, approximately 61% of which are male, with about 2 adults in the household and out of which 73% are married, 7% are divorced and 41.5% are retired. *Panel B* shows that the average annual labor income is about 222,000 Danish kroner (DKK). Pension income (payouts from pension retirement funds) is on average 49,000 DKK a year, (although people that have not retired have zero pension payouts). The total contributions to pensions are on average about 21,000 DKK a year. *Panel C* shows the financial assets and liabilities (beyond mortgages). Individuals in our sample keep on average 91,000 DKK in liquid bank deposits, 35,000 DKK in stocks, 52,000 DKK in bonds and 32,000 DKK in loans. *Panel D* shows that housing assets are on average 1,007,000DKK, with a mortgage value of about 134,000DKK and mortgage payments of about 34,000DKK a year. These payments represent on average about 22% of the individual's labor income.

[INSERT TABLE 2 ABOUT HERE]

d. Identification of behavioral change

We analyze individual responses using a simple event-study methodology to predict values for individual *i*, at runoff time *t* with the following estimating equation:

$$Y_{i,t} = +\beta_1 After_{i,t} \times \overline{Payment} + \beta_2 After_{i,t} \times (Payment_i - \overline{Payment}) + \lambda_t + \alpha_i + \varepsilon_{i,t}, \qquad (1)$$

where $Y_{i,t}$ is either annual labor income in year *t* or the annual change in a financial balance between years *t-1* and *t*. $Payment_i$ is the estimated annual mortgage payment (in thousands of DKK) calculated as the value of the mortgage three years prior to the anticipated final payment divided by

[7] When our regressions have the individual's working status as the outcome we further drop 8,968 individuals for whom the working status is missing.

[8] The exchange rate between DKK and U.S. dollar was 14.94% at the beginning of our sample in 1998, averaged 16.27% over the sample and was 17.81% at the end of our sample in 2013.

three; $\overline{Payment}$ is the average value of the payment in the regression sample. The dummy variable *After* is equal to 1 if the year is one, two, or three years after the anticipated final payment and 0 if it is one, two, or three years before. We omit the year in which the payment is anticipated to end to circumvent the fact that different mortgages run out at different times in the year and therefore individuals benefit from different levels of increased liquidity within that year. An individual-level dummy variable (α_i) which absorbs all time-invariant effects at the individual level and a year dummies (λ_t) that absorb year effects are included in all specifications unless otherwise specified.

This specification allows two different strategies – both intended to reveal the causal effect of the run-off on the outcomes of interest – to be shown and compared in the same regression. The coefficients β_1 and β_2 both show what fraction of the wealth freed up by the mortgage run-off is allocated to the outcome of interest.

The first (and simplest) identification strategy is a before- versus after-run-off comparison; we scale the $After_{i,t}$ variable by the size of the average mortgage payment ($\overline{Payment}$) so that its coefficient (β_1) can be interpreted as the before- versus after-run-off change in the outcome of interest as a proportion of an average-sized mortgage payment. For this before- versus after-run-off to accurately measure the causal effect of a run-off, the location of the discontinuity must be uncorrelated with the errors. In our case, a comparison of pre- and post-run-off behavior will only reveal the true effect of relaxing the saving constraint if the exact timing of the run-off is exogenous. Given that the exact run-off date had been chosen many years in the past -- typically among a set of round-numbered options -- this assumption appears relatively benign.

The second (and our preferred) identification strategy allows a weaker assumption about the endogenous timing of run-offs by comparing the before- and after-run-off patterns in the outcome of interest for those with small and large mortgages. We examine how economic outcomes change post-run-off as mortgage payment size – and with it, the amount of wealth freed up by the run-off – gets bigger. The coefficient on the $After_{i,t} \times (Payment_i - \overline{Payment})$ interaction (β_2) captures how the before- versus after-run-off difference in the outcome of interest change as the size of the mortgage payment increases. The coefficient β_2 has the appealing interpretation of showing how an additional kroner of mortgage payment is allocated after the run-off, comparing smaller mortgages to larger ones. This identification strategy will be unbiased as long as there are no differences between large and small mortgages in the degree to which run-off timing is endogenous.

4. Results

We present our baseline results in Table 3, estimating equation (1) with labor income and changes in bank account, stock, bond, and bank loan balances.[9] We find that on average individuals adjust only two of the margins we study: labor income and other bank loans. We find no statistically significant evidence of differences in stock, bond, or bank account balance accumulation before versus after the run-off.

The estimated coefficient on $After_{i,t} \times \overline{Payment}$ ($\beta_1 = -0.14$, 95% C.I. -0.20 to -0.087) and $After_{i,t} \times (Payment_i - \overline{Payment})$ ($\beta_2 = -0.39$, 95% C.I. -0.67 to -0.10) provide two different estimates of the share of the wealth freed up by a run-off is offset that is offset a subsequent reduction in labor income. For an average 34,000 DKK mortgage payment, these estimates indicate that labor income drops by approximately 5,000 DKK or 13,000 DKK (2 percent and 6 percent of average annual income) following the run-off, respectively. These estimates suggest that 14 percent or 39 percent of the money freed up by the run-off is "spent" on increased leisure (e.g., working fewer hours or earning less per hour - probably in a job with less intensity).

Bank loans are typically large and infrequent, which increases the estimation error on our estimated effect of run-offs on changes in bank loan balances. Our direct before versus after comparison $After_{i,t} \times \overline{Payment}$ ($\beta_1 = -0.09$, 95% C.I. -0.23 to 0.043) shows no statistically significant evidence that run-offs affect changes in bank loan balances. However, comparing smaller and larger mortgages before and after the run-off using $After_{i,t} \times (Payment_i - \overline{Payment})$ ($\beta_2 = -0.53$, 95% C.I. -1.00 to -0.050) indicates that 53 percent of the additional wealth freed up by larger mortgage payments after the run-off goes to larger reductions in bank loan balances. This provides evidence that borrowers are substituting one form of saving (mortgage principal payments) for another (paying down bank loans) after the run-off.

[INSERT TABLE 3 ABOUT HERE]

Because theory suggests individuals with different assets and debt should respond differently to a relaxation of the saving constraint, we divide our sample into four groups depending on people's financial position three years prior to the run-off (when we predict the expected run-off year): a) people with no financial assets (i.e., no stock nor bond holdings) and no bank loan debt; b) people with no financial assets but with bank loan debt; c) people with financial assets (i.e., some stock or

[9] All regressions control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. Standard errors are clustered at the individual level.

some bond holdings) and no bank loan debt; and d) people with financial assets and bank loan debt.[10] Table 4 shows the same analysis as Table 3 but for each of these four groups.

[INSERT TABLE 4 ABOUT HERE]

The reduction in labor supply found in the average results is driven by individuals who had no assets and no other debt at the moment of the run-off. A simple before versus after comparison $After_{i,t} \times \overline{Payment}$ ($\beta_1 = -0.16$, 95% C.I -0.23 to -0.091) shows that the before- versus after-run-off difference in labor income is 16 percent of the size of a typical mortgage run-off. Our comparison exploiting differences in mortgage payment size $After_{i,t} \times (Payment_i - \overline{Payment})$ ($\beta_2 = -0.47$, 95% C.I. -0.74 to -0.19) suggests that as mortgage payments – and with them, the amount of money freed up by the run-off) increase, the before- versus after-run-off difference in labor income is reduced by 47 percent of that amount. Because these individuals have neither substantial assets not debts in the years prior to the run-off, they may be "hand to mouth" consumers who consume all disposable income. They are the most likely to be constrained by the savings constraints imposed by the mortgage, or to act as if they are constrained. For this group, we show evidence that a non-trivial share of the money freed up by the run-off goes to increased leisure, as proxied by reduced labor income. The labor supply responses for those with assets or debts prior to the run-off are generally small and statistically indistinguishable from zero, consistent with a view that the consumption (of goods or leisure) is not constrained by their schedule of mortgage payments

The noisiness of bank loan data limits our ability to cleanly identify different effects of the run-off on changes in bank loans for different groups. However, examining individuals with debts but not assets prior to the run-off provides some evidence that this group merely substitutes paying off mortgage debt for paying off other debt one-for-one. Comparing the before- versus after-run-off changes in bank loan balances by mortgage payment size, larger mortgage payments are associated with larger reductions in bank loans after the run-off. While estimates are noisy, we cannot reject the hypothesis that the offset is one-for-one $After_{i,t} \times (Payment_i - \overline{Payment})$ ($\beta_2 = -1.31$, 95% C.I. -2.81 to 0.20) While simpler before versus after comparisons $After_{i,t} \times \overline{Payment}$ ($\beta_1 = 0.13$, 95% C.I. -0.26 to 0.52) yield smaller and insignificant estimates, such estimates are are potentially problematic to interpret when splitting the sample on pre-run-off debt. While the timing of the run-off may be exogenous, the timing of pre-run-off debt accumulation may not be, making those that take out debt in the six to three years prior to the run-off a highly selected and non-random

[10] Specifically, individuals are identified as holding stocks and bonds if the value of their end-of-year stocks and bonds holdings combined is higher than 50,000DKK on average six to three years before the predicted final payment. Similarly, they are identified as having bank loan debt if their end-of-year debt is higher than 50,000DKK on average six to three years before the predicted final payment.

group with respect to their plans to pay down bank debt after the run-off .While these results compare outcomes before and after the run-offs, they say little about the year-to-year dynamics of labor income or changes in bank loans in the years surrounding the run-offs.

To better understand the dynamics of our outcomes of interest, Figures 2 and 3 plot run-off-year-specific coefficients from regressions that mirror the ones in Tables 3 and 4, replacing $After_{i,t}$ dummy variables (and their interaction with mortgage payment) with dummy variables for each run-off year (and their interaction with mortgage payment).[11] Labor incomes are relatively smooth in the years prior to the run-off and the level of labor income does not jump at the run-off year (Figure 2). Instead, the slope gets steeper (more negative) after the run-off so that labor incomes drop faster year-to year after the run-off. While this finding is inconsistent with a classic life-cycle model in which leisure could be adjusted costlessly, it could be explained by an increased rate of search for (and therefore switching to) lower-pay or lower-hours work after the run-off.

Changes in bank loans increase sharply in the three years prior to the run-off, and then drop abruptly after the run-off (Figure 3). This pattern can be understood as an attempt to circumvent the saving forced by the mortgage payment schedule in the final years of the mortgage to smooth consumption or other saving. This run-up is particularly pronounced among those without bank loans six to three years before the run-off. While those with substantial bank loans six to three years prior to the run-off do not exhibit this pattern, we suspect that these results are compromised by the autocorrelation in taking out bank loans, with those who recently took out bank loans being less likely to do so in subsequent years.

5. Robustness Checks

a. Retirement and pension savings

Because the timing of mortgage run-offs could coincide with the timing of retirement, we investigate the robustness of our results in the sub-sample of individuals that do not retire during the event-study. In this context, changes to labor income can be interpreted as changes along the intensive margin. Table A1 shows the results of estimating equation (1) for individuals that do not retire at any point in time. The results show that individuals without any assets nor debt still decrease their labor income once the mortgage runs off ($After_{i,t} \times (Payment_i - \overline{Payment})$, $\beta_2 = -0.53,$), and

[11] The regressions used to construct Figures 2 and 3 only include controls for the number of years since runoff (either as dummies or in linear form in columns 1) or their interaction with the annual mortgage payment (in columns 2).

individuals with no assets but some accumulated debt use the resources freed up by the mortgage run-off to pay down their debt ($After_{i,t} \times (Payment_i - \overline{Payment})$, $\beta_2 = -2.92,$).

[INSERT TABLE A1 ABOUT HERE]

To further quantify the extensive margin of the labor supply decision, Table A2 presents the coefficients from fixed effect logit regressions on the probability of retiring and becoming unemployed. Retirement and unemployment are defined as going from unretired to retired and employed to unemployed in a given year, respectively.[12] The results show a lower propensity to retire once the mortgage runs off (the coefficient of -2.79 on $After_{i,t} \times \overline{Payment}$ represents an odd ratio about 6 percentage point lower).

[INSERT TABLE A2 ABOUT HERE]

Finally, because individuals near retirement could also use their pension savings as an adjustment margin, Table A2 also presents OLS regressions on pension outflows and inflows. The results provide no evidence of adjustments along these margins.

b. New mortgages

Individuals could also contract new mortgages (or prepay their current mortgage) as a way to adjust their consumption-savings plan. In such cases, we would not expect to find adjustments along other savings margin if the substitution is from a mortgage that is running off to a new mortgage. To test this hypothesis, we estimate the propensity to take out a new mortgage (defined as an increase in mortgage balance greater than 500,000 DKK in a given year, i.e. the extensive margin) and on the size of any mortgage (i.e. the intensive margin). Table A3 shows no change in the propensity to take out a new mortgage when comparing the years before and after the original mortgage runs off. Conditional on taking out a new mortgage, the size of the mortgage tends to vary across groups of individuals that are differently constrained.

[INSERT TABLE A3 ABOUT HERE]

c. Robustness to compliance schemes and econometric specification

Our main analysis uses the predicted date of mortgage run-off as the event relaxing the savings constraint, which can be interpreted as estimating the causal effect as an intent-to-treat. Because such compliance scheme should not affect the estimated effects we find, in this section we re-estimate our

[12] Being employed is defined as receiving labor income during the calendar year, alternatively, being unemployed is defined as any form of unemployment (including being on leave for maternity or medical reasons, being a student, being retired or being on poverty cash benefits).

baseline equation (1) using different compliance schemes. We calculate the same models as presented in Table 3 but we impose additional further restrictions of decreasing mortgage balances up to (i) two years prior to predicted run-off year, (ii) one year prior to predicted run-off year, and (iii) the year of the run-off event. These three alternative definitions of compliance make tighter restrictions of our baseline definition of glide path where we only require individuals to have decreasing mortgage balances in year six through three prior to run-off. Table A4 shows that our results about decreasing labor income and bank loans are robust to the different specifications of compliance.

[INSERT TABLE A4 ABOUT HERE]

Our main analysis groups individuals according to their financial assets and debt holdings in the period six years to three years prior to the predicted final mortgage payment. An alternative way to classify individuals is to group them according to these holdings in the entire run-off period (i.e. the six years leading up to the mortgage payment). This alternative grouping accounts for changes in household balance sheets leading up to the run-off. The results are presented in Table A5 and are quantitatively similar to our main analysis.

[INSERT TABLE A5 ABOUT HERE]

Finally, we test the robustness of our main findings to the econometric specification used. We re-estimate our main effects on changes in labor income and bank loans using different controls in Table A6. The results of columns (4) and (5) show that it is important to control for linear event-time and its interaction with the size of the mortgage payment to control for potentially different trends across individuals with high and low mortgage payments.

[INSERT TABLE A6 ABOUT HERE]

d. Household-level analysis

In our main analysis, the unit of observation is an individual. In cases where both spouses within a household have their names on the mortgage contract the value of the mortgage is split across these two individuals in the data. Because there could be interactions in the labor supply decision within households, we re-estimate our main specifications by grouping individuals in three different ways. First, we sum up all studied outcomes at the household-level (whether the mortgage is held by only one of the spouse or both), second we sum up all studied outcomes at the household level only when both spouses are on the mortgage contract, and finally we look at the spouses for which the mortgage contract only appears under their partner’s name (“non-run-off spouses”).

The results of Table A7 show no effect of the mortgage run-off for non-run-off spouses (Panel C.). This suggests that within a household the spouses make separate financial decisions. Because the non-run-off spouses show no statistically significant effect, including them in the household-level analysis mostly adds noise (Panel A.). Looking at household-level outcomes but excluding non-run-off spouses yields qualitatively and quantitatively similar results as our main analysis (Panel B.).

[INSERT TABLE A7 ABOUT HERE]

e. Placebo analysis

Finally, our main analysis excludes individuals for whom the mortgage payment as a fraction of their labor income is lower than 10%. For these individuals, we do not expect the mortgage run-off to relax a quantitatively important saving constraint. If this is the case, such individuals can be used in a placebo analysis where we compare their behavior before and after the mortgage run-off to the behavior of individuals for whom the mortgage payment is substantial (i.e. higher than 10% of their labor income). To this end, we re-estimate our main specification on the entire sample of individuals for whom we identified a mortgage runoff (77,790 individuals) while identifying individuals for whom the mortgage payments are substantial using a dummy variable called High Pmts. The results show that most of the results presented in our main analysis are driven by individuals with high mortgage payments..

6. Conclusions

This paper documents consumers' responses to a change in saving commitments. Because mortgages commit borrowers to a repayment schedule that pays down their mortgage balance, a mortgage run-off relaxes a saving commitment. This saving commitment does not bind for consumers who choose to save more than is required by the mortgage contract or who borrow elsewhere to undo the saving requirement of the mortgage. Theory predicts that such consumers should not adjust their consumption but should increase savings or decrease debt one-for-one with mortgage payments once they cease. We find that individuals with pre-run-off debts (but without pre-run-off assets) – for whom the mortgage saving commitment should not bind – perfectly offset the end of the mortgage saving commitment by paying down other debt post-run-off one-for-one. For this subset of borrowers, they work around the saving constraint of the mortgage just as theory would suggest.

Borrowers with neither pre-run-off savings or other debt are most likely to be constrained by the mortgage saving requirement to save more and spend less than they would like pre-run-off. We find that these borrowers reduce labor supply post-run-off, increasing their consumption of leisure once they are no longer forced to saving by paying down their mortgage balance. The savings constraint imposed by the mortgage binds for these borrowers. In contrast with other tests of PIH-type models, our setting does not require that individuals rationally anticipate the mortgage run-off. Whereas standard empirical tests of the PIH are a joint test of rational anticipation and respond to income changes, our predictions are the same whether individual rationally anticipate or not the change in saving commitment

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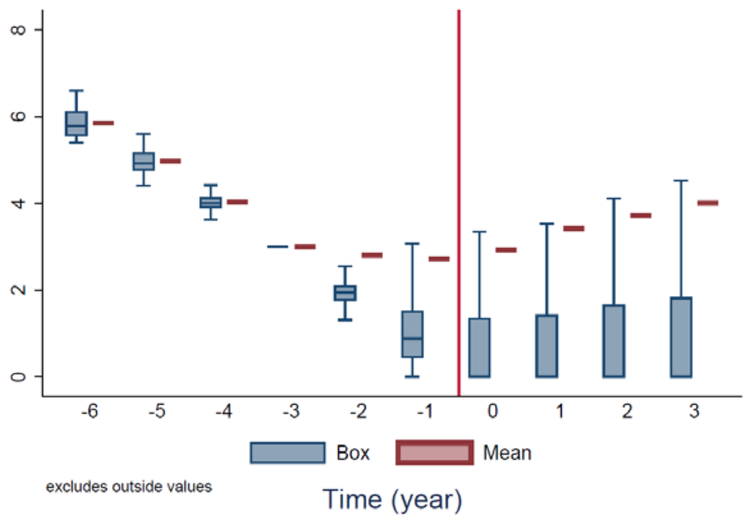
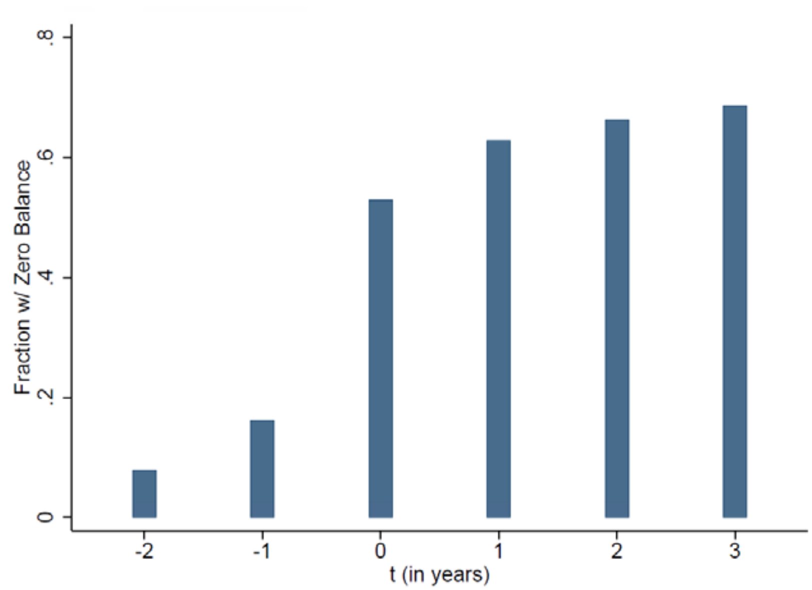
Figure 1. Mortgage Runoffs Identification



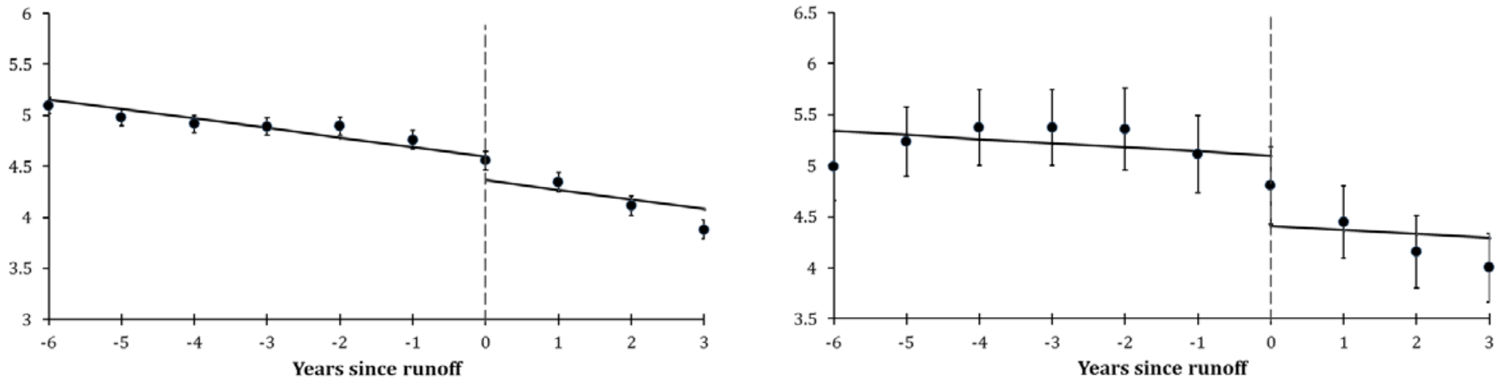
(a) Mortgage value as a proportion of its value three years prior to the anticipated final payment



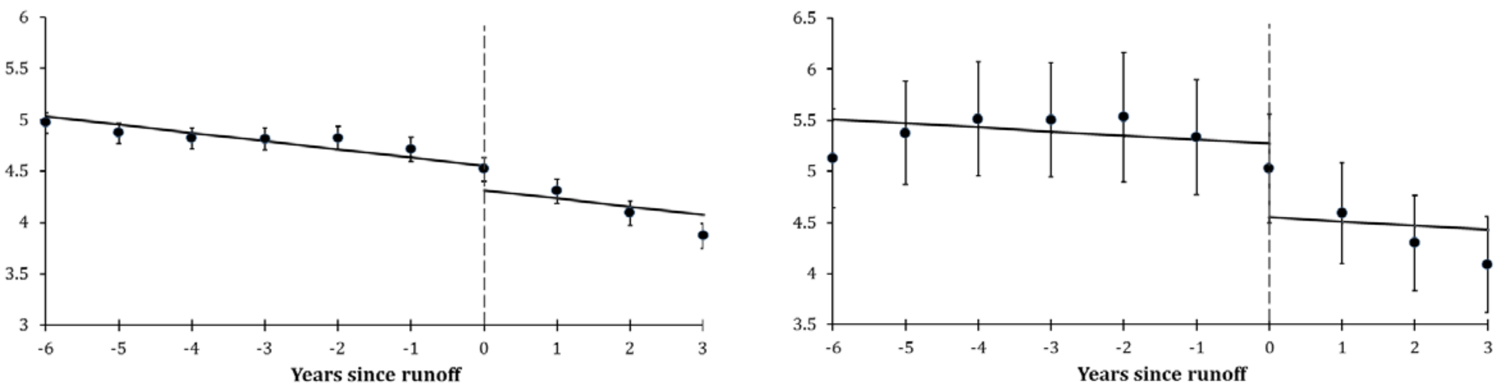
(b) Proportion of individuals with a zero mortgage value

Figure 2. Labor Income

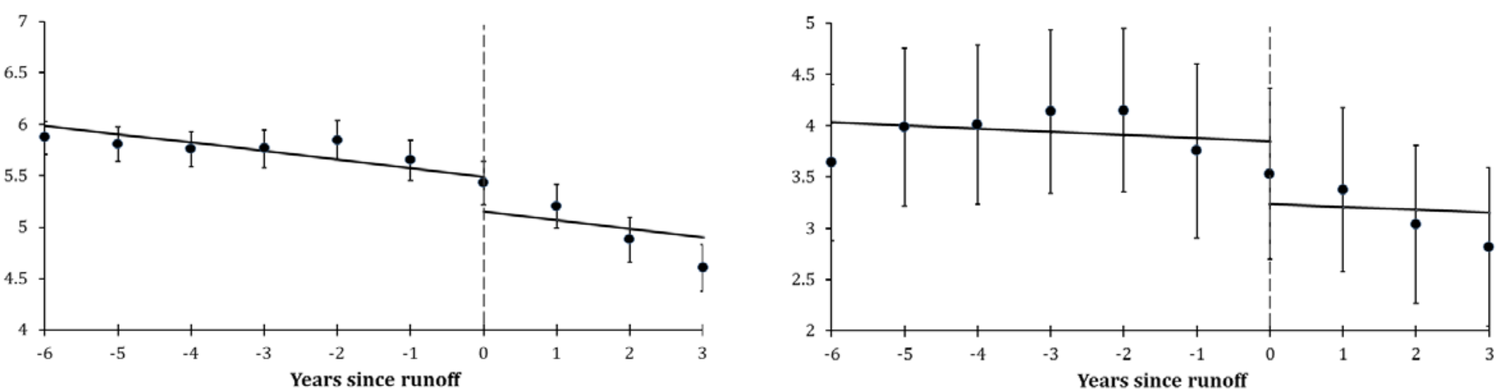
Column 1: Years since runoff dummies Column 2: Years since runoff dummies x payment



i) Full sample



ii) No assets, no debt sample

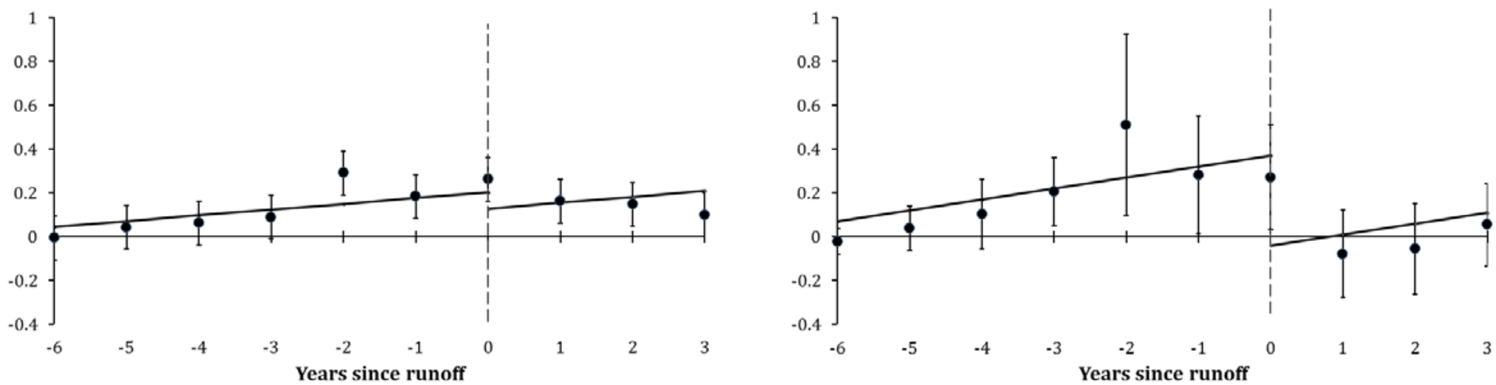


iii) No assets, yes debt sample

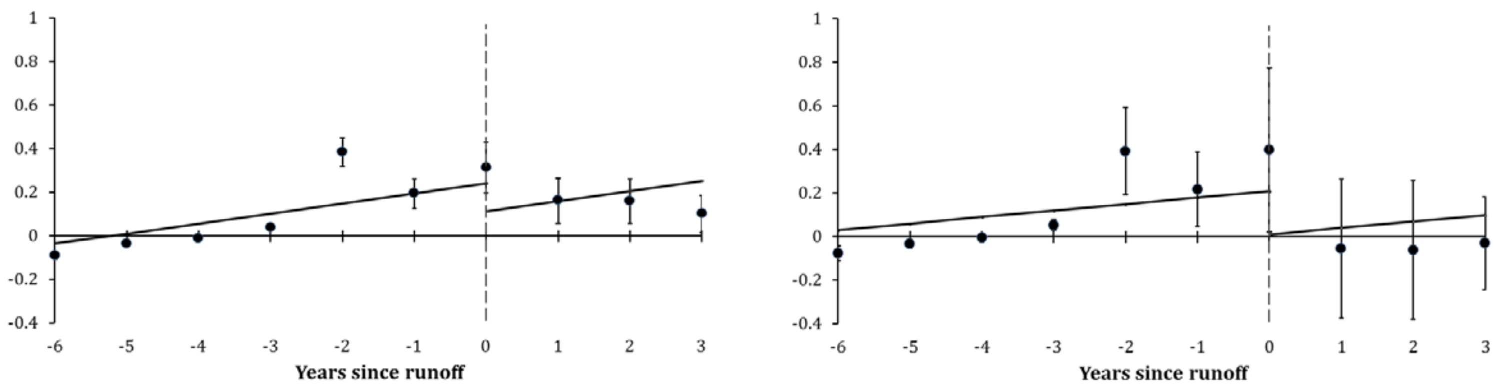
Footnote: This figure plots the results of OLS regressions on labor income using various specifications and samples. All coefficients are centered on the mean mortgage payment of the sample used in the regressions. The first column shows the results from two regressions: the first regression includes only years since runoff dummies, and the second regression includes only linear years since the runoff and a dummy variable equal to zero in the years prior to the final payment and one in the years after. The black dots show the coefficients on the runoff dummies (along with their 95% confidence interval) while the full line presents the prediction of the linear model. The second column presents the results from two regressions: the first includes years since runoff dummies, the mortgage payment and their interaction, and the second regression includes linear years since runoff, mortgage payment, a dummy variable equal to zero in the years prior to the final payment and one in the years after, as well as the interactions between the mortgage payment and the linear runoff years as well as the interaction between the mortgage payment and the dummy variable for the after period. The black dots present the coefficients of years since runoff dummies multiplied by the mortgage payment plus the baseline coefficient on the mortgage payment (along with 95% confidence intervals) while the full line presents the prediction of the linear model. The first line uses the full sample of mortgage runoffs, the second line uses the sample of individuals that had no assets nor debt in the period six to three years prior to the runoff, and the third line uses the sample of individuals that had no assets but some debt in the period six to three years prior to the runoff.

Figure 2. Bank Loans

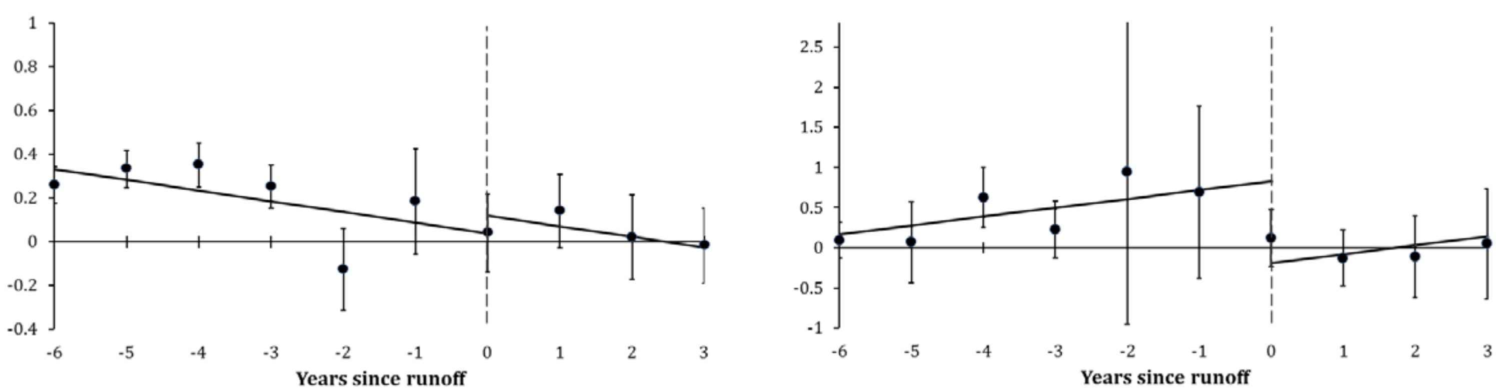
Column 1: Years since runoff dummies | Column 2: Years since runoff dummies x payment



i) Full sample



ii) No assets, no debt sample



iii) No assets, yes debt sample

Footnote: This figure plots the results of OLS regressions on changes in bank loan value from year-to-year using various specifications and samples. All coefficients are centered on the mean mortgage payment of the sample used in the regressions. The first column shows the results from two regressions: the first regression includes only years since runoff dummies, and the second regression includes only linear years since the runoff and a dummy variable equal to zero in the years prior to the final payment and one in the years after. The black dots show the coefficients on the runoff dummies (along with their 95% confidence interval) while the full line presents the prediction of the linear model. The second column presents the results from two regressions: the first includes years since runoff dummies, the mortgage payment and their interaction, and the second regression includes linear years since runoff, mortgage payment, a dummy variable equal to zero in the years prior to the final payment and one in the years after, as well as the interactions between the mortgage payment and the linear runoff years as well as the interaction between the mortgage payment and the dummy variable for the after period. The black dots present the coefficients of years since runoff dummies multiplied by the mortgage payment plus the baseline coefficient on the mortgage payment (along with 95% confidence intervals) while the full line presents the prediction of the linear model. The first line uses the full sample of mortgage runoffs, the second line uses the sample of individuals that had no assets nor debt in the period six to three years prior to the runoff, and the third line uses the sample of individuals that had no assets but some debt in the period six to three years prior to the runoff.

Table 1. Predicted Change in Behavior to Income or Saving Commitments Changes

	Anticipation of the Change	
	Anticipated	**Unanticipated**
Change in income	Changes in income do not affect consumption	Consumption changes proportionally to change in income
Removal of saving commitment *without* borrowing constraints	Resources freed up from the saving commitment are shifted to other types of saving Consumption and leisure do not change.	Resources freed up from the saving commitment are shifted to other types of saving Consumption and leisure do not change.
Removal of saving commitment *with* borrowing constraints	Resources freed up from the saving commitment are used to take on more debt and increase consumption or leisure.	Resources freed up from the saving commitment are used to take on more debt and increase consumption or leisure.

Table 2. Descriptive Statistics

	Mean		Std. Dev.
A. Demographics			
Age	56.9		10.3
Male	61.2	%	-
# Adults in household	1.9		0.6
Married	72.7	%	-
Divorced	7.2	%	-
Retired	41.5	%	-
B. Income and Pensions ('000s DKK)			
Labor Income	222.0	DKK	112.7
Total Pension Outflows	48.7	DKK	70.3
Total Pension Inflows	20.7	DKK	49.1
C. Wealth ('000s DKK)			
Bank Deposits	91.3	DKK	157.2
Stocks	35.1	DKK	152.5
Bonds	51.5	DKK	346.3
Bank Loans	31.7	DKK	85.2
D. Housing ('000s DKK)			
Housing Assets	1,006.8	DKK	683.8
Mortgage Value	134.1	DKK	73.2
Mortgage Payments	33.7	DKK	18.6
Mortgage Payments/Income	22.2	%	1.7

This table provides descriptive statistics for the main variables used in the analysis. The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off. There are 15,895 runoff events. All variables are recorded at the end of the calendar year and are measured three years prior to the year in which the mortgage is paid off. Labor income and mortgage payments are annual. All monetary amounts are expressed in Danish kroner (DKK). The exchange rate between DKK and U.S. dollar was 14.94% at the beginning of our sample in 1998, averaged 16.27% over the sample and was 17.81% at the end of our sample in 2013.

Table 3. Average Results

	Labor Income	Bank Deposits	Stocks	Bonds	Bank Loans
After x	-0.14***	-0.17**	-0.03	-0.04	-0.09
$\overline{\text{Payment}}$	(0.03)	(0.09)	(0.05)	(0.07)	(0.07)
After x	-0.39***	-0.12	0.07	-0.15	-0.53**
$(\text{Payment}-\overline{\text{Payment}})$	(0.14)	(0.34)	(0.12)	(0.18)	(0.24)
R^2	0.061	0.001	0.015	0.002	0.004

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off. There are 15,895 runoff events. Dependent variables are labor income, measured as total income in thousands of Danish kroner (DKK) received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in thousands of DKK from their value at the end of the previous calendar year. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is the average annual mortgage payment in thousands of DKK three to six years before the mortgage is paid off, as reported in Table 2. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table 4. Wealth Effects

	Labor Income	Bank Deposits	Stocks	Bonds	Bank Loans
A. No Stocks+Bonds, No Debt (No. of runoffs = 10,058)					
After x $\overline{\text{Payment}}$	-0.16***	-0.14	-0.06*	-0.07	-0.17**
	(0.04)	(0.10)	(0.03)	(0.07)	(0.09)
After x (Payment-$\overline{\text{Payment}}$)	-0.47***	-0.19	-0.20*	0.15	-0.41
	(0.14)	(0.40)	(0.11)	(0.19)	(0.26)
R^2	0.058	0.002	0.012	0.001	0.002
B. No Stocks+Bonds, Yes Debt (No. of runoffs = 2,467)					
After x $\overline{\text{Payment}}$	-0.13*	-0.12	-0.02	-0.13	0.13
	(0.07)	(0.16)	(0.03)	(0.11)	(0.20)
After x (Payment-$\overline{\text{Payment}}$)	0.02	-0.59*	-0.10	-0.61	-1.31*
	(0.16)	(0.35)	(0.11)	(0.46)	(0.77)
R^2	0.072	0.002	0.016	0.004	0.011
C. Yes Stocks+Bonds, No Debt (No. of runoffs = 2,996)					
After x $\overline{\text{Payment}}$	-0.06	-0.34	-0.02	0.05	-0.22*
	(0.06)	(0.26)	(0.24)	(0.25)	(0.13)
After x (Payment-$\overline{\text{Payment}}$)	0.10	-0.80	0.76	-0.38	-0.89**
	(0.16)	(0.81)	(0.47)	(0.58)	(0.41)
R^2	0.05	0.003	0.11	0.023	0.004
D. Yes Stocks+Bonds, Yes Debt (No. of runoffs = 374)					
After x $\overline{\text{Payment}}$	-0.32	0.02	0.04	0.45	0.8
	(0.22)	(0.57)	(0.51)	(0.48)	(0.56)
After x (Payment-$\overline{\text{Payment}}$)	-2.93**	4.89**	-0.10	-0.94	0.79
	(1.47)	(2.28)	(0.83)	(0.67)	(1.61)
R^2	0.152	0.026	0.015	0.007	0.02

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off. Dependent variables are labor income, measured as total income in thousands of Danish kroner (DKK) received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in thousands of DKK from their value at the end of the previous calendar year. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is the average annual mortgage payment in thousands of DKK three to six years before the mortgage is paid off, as reported in Table 2. It is equal to 31.84, 38.61, 34.51, and 46.57 for individuals in Panels A., B., C., and D., respectively. An individual is identified as having debt if her end-of-year debt is higher than 50,000 DKK on average six to three years before the predicted final payment. Similarly, an individual is identified as holding stocks and bonds if the value of her end-of-year stocks and bonds combined is higher than 50,000 DKK on average six to three years before the predicted final payment. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A1. Excluding individuals who retire

	Labor Income	Bank Deposits	Stocks	Bonds	Bank Loans
A. All Sample (No. of runoffs = 5,770)					
After x	-0.04	-0.11	-0.05	-0.05	-0.23**
$\overline{\text{Payment}}$	(0.04)	(0.12)	(0.06)	(0.07)	(0.11)
After x	-0.50	0.17	-0.29	-0.14	-1.18**
(Payment-$\overline{\text{Payment}}$)	(0.33)	(0.63)	(0.21)	(0.18)	(0.48)
R^2	0.047	0.003	0.009	0.001	0.007
B. No Stocks+Bonds, No Debt (No. of runoffs = 3,368)					
After x	0.01	-0.13	0.13**	0.09*	0.15
$\overline{\text{Payment}}$	(0.07)	(0.16)	(0.05)	(0.05)	(0.10)
After x	-0.56*	0.26	-0.36	0.17*	-0.44
(Payment-$\overline{\text{Payment}}$)	(0.33)	(0.49)	(0.27)	(0.10)	(0.29)
R^2	0.052	0.004	0.014	0.003	0.003
C. No Stocks+Bonds, Yes Debt (No. of runoffs = 1,231)					
After x	-0.04	-0.35	0.05	0.06	-0.91***
$\overline{\text{Payment}}$	(0.08)	(0.25)	(0.04)	(0.06)	(0.30)
After x	-0.07	-0.16	0.01	-0.46	-2.92**
(Payment-$\overline{\text{Payment}}$)	(0.20)	(0.70)	(0.07)	(0.40)	(1.30)
R^2	0.055	0.003	0.022	0.005	0.025
D. Yes Stocks+Bonds, No Debt (No. of runoffs = 0,956)					
After x	0.02	0.46	-0.42	-0.66*	0.22
$\overline{\text{Payment}}$	(0.12)	(0.42)	(0.32)	(0.38)	(0.28)
After x	0.42	-0.69	0.07	-0.09	-0.05
(Payment-$\overline{\text{Payment}}$)	(0.29)	(0.65)	(0.73)	(0.71)	(0.35)
R^2	0.035	0.01	0.138	0.013	0.006
E. Yes Stocks+Bonds, Yes Debt (No. of runoffs = 215)					
After x	0.09	-1.43*	-0.16	-0.07	-0.86
$\overline{\text{Payment}}$	(0.26)	(0.82)	(0.84)	(0.86)	(0.94)
After x	-2.77	2.42	-1.17	-0.06	-1.71
(Payment-$\overline{\text{Payment}}$)	(1.73)	(4.14)	(1.02)	(0.65)	(2.86)
R^2	0.148	0.035	0.016	0.01	0.036

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off, with the additional restriction that we drop individuals who are retired at any point of the sample. Dependent variables are labor income, measured as total income in DKK received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in DKK levels with respect to their value at the end of the previous calendar year. An individual is identified as having debt if her end-of-year debt is higher than 50,000 DKK on average in the six years before the predicted final payment. Similarly, we say an individual is identified as holding stocks and bonds if the value of her end-of-year stocks and bonds combined is higher than 50,000 DKK on average in the six years before the predicted final payment. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is a variable equal to the average annual mortgage payment three to six years before the mortgage is paid off. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A2. Pension, Retirement, and Unemployment

	Pension			
	Outflows	Inflows	Retirement	Unemployment
After	0.90	1.45	-2.79***	-0.52
	(1.04)	(2.28)	(0.52)	(0.40)
After x Payment	0.03	-0.09		
	(0.03)	(0.08)		
After x Payment/100,000			0.53	-0.69
			(1.32)	(0.99)
R^2	0.182	0.0094	0.7591	0.054
No. of Runoffs	15,895	15,895	2,908	1,159

This table shows OLS regressions on pension outflows and inflows, as well marginal effects derived from logit regressions on the probability of retiring and becoming unemployed. All regressions control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. Pension outflows and inflows are the sum of employer and private pensions measured in thousands of Danish kroner (DKK) at the end of the year. Retirement and unemployment are defined as going from unretired to retired, and employed to unemployed in a given year, respectively. Being employed is defined as receiving a salary during the calendar year, alternatively, being out of the labor force is defined as any form of unemployment (including being on leave for maternity or medical reasons, being a student, being retired or being on poverty cash benefits). The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is the average annual mortgage payment in thousands of DKK three to six years before the mortgage is paid off, as reported in Table 2. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A3. New Mortgage

	All	No Stock+Bond, No Debt	No Stock+Bond, Yes Debt	Yes Stock+Bond, No Debt	Yes Stock+Bond, Yes Debt
A. Extensive Margin					
After	-0.63	-0.66	-0.56	-1.25	-0.36
	(0.39)	(0.57)	(0.72)	(1.12)	(2.02)
After x Payment	-0.44	0.32	-1.55	-0.04	-0.09
	(0.71)	(1.11)	(1.23)	(1.99)	(3.25)
R^2	0.0253	0.031	0.0302	0.0365	0.0581
B. Intensive Margin					
After x	-31.78**	-1.57	-46.53***	-69.98***	3.39
$\overline{\text{Payment}}$	(14.50)	(12.20)	(13.47)	(19.19)	(12.41)
After x	20.07*	0.95	45.74**	289.84***	8.81
(Payment-$\overline{\text{Payment}}$)	(12.07)	(8.45)	(20.89)	(18.35)	(15.11)
R^2	0.2087	0.5304	0.6735	0.8141	0.6066
No. of Observations	934	489	262	140	43

This table shows the extensive and intensive margins of new mortgage takeout. We call an annual increase in mortgage balance greater than 500,000 DKK a new mortgage. Panel A. shows the coefficients of logit regressions on a binary variable equal to one if the individual has a new mortgage in a calendar year and zero otherwise. All regressions control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is the average annual mortgage payment three to six years before the mortgage is paid off (expressed in millions of DKK in Panel B.) An individual is identified as having debt if her end-of-year debt is higher than 50,000 DKK on average six to three years before the predicted final payment. Similarly, an individual is identified as holding stocks and bonds if the value of her end-of-year stocks and bonds combined is higher than 50,000 DKK on average six to three years before the predicted final payment. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A4. Compliance Analysis

	Labor Income	Bank Deposits	Stocks	Bonds	Bank Loans
A. Compliance at T0-3 (No. of runoffs = 15,895)					
After x	-0.14***	-0.17**	-0.03	-0.04	-0.09
$\overline{\text{Payment}}$	(0.03)	(0.09)	(0.05)	(0.07)	(0.07)
After x	-0.39***	-0.12	0.07	-0.15	-0.53**
(Payment-$\overline{\text{Payment}}$)	(0.14)	(0.34)	(0.12)	(0.18)	(0.24)
R^2	0.061	0.001	0.015	0.002	0.004
B. Compliance at T0-3 and T0-2 (No. of runoffs = 14,389)					
After x	-0.16***	-0.20**	-0.01	0.02	-0.15**
$\overline{\text{Payment}}$	(0.03)	(0.09)	(0.06)	(0.07)	(0.06)
After x	-0.42***	0.01	0.11	0.00	-0.44*
(Payment-$\overline{\text{Payment}}$)	(0.16)	(0.33)	(0.13)	(0.18)	(0.24)
R^2	0.066	0.001	0.015	0.003	0.004
C. Compliance at T0-3, T0-2, and T0-1 (No. of runoffs = 12,145)					
After x	-0.20***	0.08	0.03	0.10	-0.23***
$\overline{\text{Payment}}$	(0.03)	(0.09)	(0.06)	(0.07)	(0.06)
After x	-0.47**	0.22	0.15	-0.02	-0.39*
(Payment-$\overline{\text{Payment}}$)	(0.18)	(0.32)	(0.14)	(0.19)	(0.21)
R^2	0.07	0.002	0.032	0.004	0.003
D. Compliance at T0-3, T0-2, T0-1, and T0 (No. of runoffs = 6,804)					
After x	-0.27***	-0.02	0.03	0.13	-0.38***
$\overline{\text{Payment}}$	(0.04)	(0.14)	(0.10)	(0.11)	(0.08)
After x	-0.39***	0.21	0.48**	-0.30	-0.59**
(Payment-$\overline{\text{Payment}}$)	(0.11)	(0.33)	(0.23)	(0.31)	(0.27)
R^2	0.081	0.002	0.034	0.005	0.004

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. The samples used vary by definition of compliance with the predicted mortgage runoff. The sample used in Panel A. is based on the mortgage runoff as predicted three years before the mortgage is paid off and the results are identical to the results presented in Table 2. The sample used in Panel B. adds the restriction that the mortgage balance is decreasing two years prior to the year in which the mortgage is paid off. TableA5_Household_Format!The sample used in Panel C. further adds the restriction that the mortgage balance is decreasing one year prior to the year in which the mortgage is paid off. Finally, the sample used in Panel D. adds the restriction that the value of the mortgage is zero in the year in which it is predicted to be paid off. Dependent variables are labor income, measured as total income in thousands of Danish kroner (DKK) received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in thousands of DKK from their value at the end of the previous calendar year. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is the average annual mortgage payment in thousands of DKK three to six years before the mortgage is paid off, as reported in Table 2. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A5. Compliance with wealth effects

	Labor Income	Bank Deposits	Stocks	Bonds	Bank Loans
A. No Stocks+Bonds, No Debt (No. of runoffs = 4,089)					
After x	-0.27***	0.06	0.02	0.13**	-0.06
$\overline{\text{Payment}}$	(0.06)	(0.16)	(0.05)	(0.05)	(0.08)
After x	-0.49***	0.25	-0.13	-0.04	-0.14
(Payment-$\overline{\text{Payment}}$)	(0.15)	(0.39)	(0.25)	(0.10)	(0.27)
R^2	0.071	0.003	0.016	0.003	0.002
B. No Stocks+Bonds, Yes Debt (No. of runoffs = 0,878)					
After x	-0.35***	-0.59*	0.11**	0.28***	-1.89***
$\overline{\text{Payment}}$	(0.12)	(0.34)	(0.05)	(0.11)	(0.33)
After x	0.01	0.21	0.09	-0.23	-0.93
(Payment-$\overline{\text{Payment}}$)	(0.23)	(1.05)	(0.11)	(0.19)	(1.15)
R^2	0.116	0.005	0.017	0.005	0.028
C. Yes Stocks+Bonds, No Debt (No. of runoffs = 1,639)					
After x	-0.17*	0.64**	-0.09	0.01	0.24*
$\overline{\text{Payment}}$	(0.09)	(0.31)	(0.37)	(0.44)	(0.13)
After x	-0.22	0.76	1.19*	-0.43	-0.09
(Payment-$\overline{\text{Payment}}$)	(0.23)	(0.71)	(0.65)	(1.27)	(0.29)
R^2	0.073	0.005	0.106	0.024	0.004
D. Yes Stocks+Bonds, Yes Debt (No. of runoffs = 198)					
After x	-0.61**	-2.02**	1.49*	-0.85	-2.46***
$\overline{\text{Payment}}$	(0.26)	(0.86)	(0.90)	(0.53)	(0.93)
After x	-1.12*	0.35	4.22**	-1.75	-0.98
(Payment-$\overline{\text{Payment}}$)	(0.63)	(1.96)	(1.95)	(1.70)	(1.83)
R^2	0.154	0.018	0.093	0.012	0.038

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. The sample used consists of individuals who fully comply with the mortgage runoff, as in Panel D. of Table A1, but the assets and debt holdings are measured in the six years prior to the predicted final payment. Dependent variables are labor income, measured as total income in DKK received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in DKK levels with respect to their value at the end of the previous calendar year. An individual is identified as having debt if her end-of-year debt is higher than 50,000 DKK on average in the six years before the predicted final payment. Similarly, we say an individual is identified as holding stocks and bonds if the value of her end-of-year stocks and bonds combined is higher than 50,000 DKK on average in the six years before the predicted final payment. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is a variable equal to the average annual mortgage payment three to six years before the mortgage is paid off. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A6. Robustness of Specifications

	(1)	(2)	(3)	(4)	(5)
A. Labor Income					
After x	-0.14***	-0.14***	-0.14***	-0.14***	-0.14***
$\overline{\text{Payment}}$	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
After x	-0.39***	-0.38***	-0.38***	-0.98***	-0.98***
(Payment-$\overline{\text{Payment}}$)	(0.14)	(0.14)	(0.14)	(0.10)	(0.10)
R^2	0.0613	0.0583	0.2698	0.0602	0.0602
B. Bank Loans					
After x	-0.09	-0.08	-0.08	-0.09	-0.09
$\overline{\text{Payment}}$	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
After x	-0.53**	-0.57**	-0.57**	-0.26**	-0.26**
(Payment-$\overline{\text{Payment}}$)	(0.24)	(0.25)	(0.25)	(0.10)	(0.10)
R^2	0.0036	0.0009	0.0014	0.0035	0.0035
Year F.E.	YES	NO	NO	YES	YES
Person F.E.	YES	YES	NO	YES	YES
Event-Time	YES	YES	YES	YES	NO
Event-Time x Payment	YES	YES	YES	NO	NO

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. Specification (1) reproduces the baseline results of Table 2. The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off. Dependent variables are labor income, measured as total income in DKK received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in DKK levels with respect to their value at the end of the previous calendar year. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is a variable equal to the average annual mortgage payment three to six years before the mortgage is paid off. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A7. Household-level analysis

	Labor Income	Bank Deposits	Stocks	Bonds	Bank Loans
A. Household-Level (Including Non-Runoff Spouses) (No. of runoffs = 12,101)					
After x $\overline{\text{Payment}}$	-0.13**	-0.25*	-0.03	-0.07	-0.24*
	(0.06)	(0.13)	(0.08)	(0.09)	(0.12)
After x (Payment-$\overline{\text{Payment}}$)	-0.35	0.14	-0.09	-0.45	-0.29
	(0.24)	(0.43)	(0.21)	(0.28)	(0.39)
R^2	0.067	0.002	0.04	0.005	0.002
B. Household-Level (Excluding Non-Runoff Spouses) (No. of runoffs = 12,973)					
After x $\overline{\text{Payment}}$	-0.16***	-0.21**	-0.04	-0.03	-0.09
	(0.03)	(0.09)	(0.06)	(0.07)	(0.07)
After x (Payment-$\overline{\text{Payment}}$)	-0.43***	-0.03	-0.01	-0.11	-0.43**
	(0.17)	(0.33)	(0.15)	(0.19)	(0.22)
R^2	0.074	0.001	0.033	0.004	0.004
C. Non-Runoff Spouses (No. of runoffs = 7,396)					
After x $\overline{\text{Payment}}$	0.03	-0.12	-0.04	-0.13	-0.13
	(0.08)	(0.14)	(0.07)	(0.08)	(0.15)
After x (Payment-$\overline{\text{Payment}}$)	0.08	0.00	-0.20	-0.58*	0.08
	(0.26)	(0.59)	(0.25)	(0.31)	(0.56)
R^2	0.027	0.001	0.017	0.002	0.001

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment. The samples used vary by definition of households. The sample used in Panel A. sums all outcomes at the level of the household, even when one of the spouse does not have a runoff recorded in the data. The sample used in Panel B. sums all outcomes at the level of the household, but omits spouses for which no runoff is recorded in the data. The sample used in Panel C. only keeps the spouses that do not have a runoff within a runoff-household. Dependent variables are labor income, measured as total income in DKK received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in DKK levels with respect to their value at the end of the previous calendar year. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. Payment is a variable equal to the average annual mortgage payment three to six years before the mortgage is paid off. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.

Table A8. Placebo (Small mortgage payments)

	Labor Income	Bank Deposits	Stocks	Bonds	Bank Loans
A. All Sample (No. of runoffs = 60,114)					
After	-1.87**	0.78	0.83	-0.08	-2.16**
	(0.77)	(1.54)	(0.89)	(1.13)	(0.99)
After x High Pmts	-2.78**	-6.72**	-2.91	-1.45	-0.96
	(1.21)	(3.25)	(2.00)	(2.47)	(2.50)
R^2	0.048	0.001	0.031	0.005	0.002
B. No Stocks+Bonds, No Debt (No. of runoffs = 36,499)					
After	-0.97	1.57	0.65	-2.17**	-4.48***
	(0.78)	(1.68)	(0.57)	(0.88)	(0.92)
After x High Pmts	-3.92***	-6.17*	-2.80**	-0.20	-0.90
	(1.36)	(3.62)	(1.22)	(2.22)	(2.87)
R^2	0.044	0.001	0.015	0.002	0.002
C. No Stocks+Bonds, Yes Debt (No. of runoffs = 10,138)					
After	-5.47*	-5.82*	-2.14**	-3.33**	10.28***
	(2.87)	(3.20)	(1.05)	(1.51)	(2.56)
After x High Pmts	0.53	1.38	1.94	-1.54	-4.94
	(3.89)	(6.69)	(1.69)	(4.21)	(7.83)
R^2	0.044	0.001	0.01	0.001	0.008
D. Yes Stocks+Bonds, No Debt (No. of runoffs = 12,017)					
After	-2.45	3.53	1.48	6.61	-8.03**
	(1.52)	(4.87)	(3.57)	(4.48)	(3.12)
After x High Pmts	0.28	-15.11	-4.86	-5.05	0.87
	(2.57)	(10.19)	(8.76)	(9.63)	(5.34)
R^2	0.063	0.002	0.138	0.027	0.001
E. Yes Stocks+Bonds, Yes Debt (No. of runoffs = 1460)					
After	6.23	6.84	12.48	2.48	12.44
	(5.94)	(10.48)	(10.87)	(10.39)	(11.10)
After x High Pmts	-23.60*	-9.59	-16.37	17.71	22.22
	(12.78)	(28.64)	(25.37)	(22.88)	(27.83)
R^2	0.082	0.005	0.028	0.007	0.008

This table shows the results of OLS regressions which control for year fixed effects, individual fixed effects, and linear runoff year and its interaction with the size of annual mortgage payment as well as with a binary variable indicating whether the individual's mortgage payment is higher than 10% of her labor income. The sample used is based on the mortgage runoff as predicted three years before the mortgage is paid off, without imposing the restriction that the mortgage payment be higher than 10% of the individual's labor income. Dependent variables are labor income, measured as total income in DKK received during the calendar year, and bank deposits, stocks, bonds and bank loans, measured as changes in DKK levels with respect to their value at the end of the previous calendar year. An individual is identified as having debt if her end-of-year debt is higher than 50,000 DKK on average in the six years before the predicted final payment. Similarly, we say an individual is identified as holding stocks and bonds if the value of her end-of-year stocks and bonds combined is higher than 50,000 DKK on average in the six years before the predicted final payment. After is a variable equal to zero in the three years before the mortgage is paid off and one in the three years after the mortgage is paid off. High Pmts is a variable equal to one if the mortgage payments are higher than 10% of labor income, and zero otherwise. Standard errors clustered at the individual level are presented in parentheses. ***, **, * represent statistical significance at the 1, 5, and 10 percent levels respectively.