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## Mandatory pension savings and long-run debt accumulation: Evidence from Danish register data

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# DANMARKS NATIONALBANK

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## Mandatory Pension Savings and Long-run Debt Accumulation: Evidence from Danish Register Data

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# Mandatory Pension Savings and Long-run Debt Accumulation: Evidence from Danish Register Data

## Abstract

This paper uses two decades of individual level information from Danish administrative registers to show that a 1-dollar increase in pension wealth leads to a 26-cent rise in total debt. We exploit time-sector variation in mandatory pension contribution rates to isolate the effect of pension wealth on the full financial balance sheet. Concerns of confounding factors are mitigated by sampling employees in identical occupations who have worked in the same sectors but at different points in time. Liquidity constraints seem to play a key role, and we couple the crowding-out effect with an increased propensity to use interest-only mortgages.

## Resume

Denne analyse anvender to årtiers information fra administrative registre på individniveau til at vise, at en stigning i pensionsformuen på 1 krone fører til en stigning på 26 øre i den samlede gæld. Vi udnytter variation på tværs af tid og sektorer i introduktionen af obligatorisk pensionsopsparing til at isolere effekten af pensionsformuen på hele den finansielle balance. Beregningerne er udført ved hjælp af en stikprøve af personer med identiske stillingsbetegnelser, som har været ansat i de samme sektorer på forskellige tidspunkter. Likviditetsbegrænsninger spiller en betydelig rolle for den øgede gældsætning, ligesom en del af effekten kan tilskrives en øget tilbøjelighed til brug af afdragsfrie realkreditlån.

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## Key words

Household debt; household balance sheets; pension savings.

## JEL classification

D14; D15; E21.

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# Mandatory Pension Savings and Long-run Debt Accumulation: Evidence from Danish Register Data\*

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June 2020

## Abstract

This paper uses two decades of individual level information from Danish administrative registers to show that a 1-dollar increase in pension wealth leads to a 26-cent rise in total debt. We exploit time-sector variation in mandatory pension contribution rates to isolate the effect of pension wealth on the full financial balance sheet. Concerns of confounding factors are mitigated by sampling employees in identical occupations who have worked in the same sectors but at different points in time. Liquidity constraints seem to play a key role, and we couple the crowding-out effect with an increased propensity to use interest-only mortgages.

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# 1 Introduction

Many countries have seen a substantial increase in household debt over the past decades, potentially affecting macroeconomic developments and financial stability.<sup>1</sup> Maturing funded pension plans are possibly playing a key role in explaining this increase in debt levels.<sup>2</sup> When forced to save in retirement accounts, savers might wish to offset the savings mandate by reducing savings in non-retirement accounts. This reaction is, however, not observed empirically. Chetty et al. (2014) examine a large panel of savers exposed to different pension contribution rates and find that savings in taxable accounts remain almost unchanged in the event of an increase in mandatory pension savings. Because of limitations in their empirical design, they are unable to test whether mortgage borrowing increases as a result of the rise in employer-provided pension contributions. This question is examined by Beshears et al. (2019) who find no significant change in debt growth as pension contributions increase. In their study, however, they have no taxable savings data available. As of now, studies in this field of research have been constrained by data availability and lack of appropriate research designs, preventing them from observing changes to the full financial household balance sheet when savings in occupational pensions rise. Our paper aims to fill this gap. We use two decades of longitudinal data in a novel research design to measure changes in both financial assets and liabilities as mandatory contribution rates for employer-provided pension plans increase. Our identification strategy constrains us to measuring the behavioural response of a very selected group of employees working within the cooking, waiting and cleaning industries. However, the design allows us to provide a full picture of crowding-out in retirement accounts and detect developments in debt and saving accounts in the long run. Despite the narrow sample selection in terms of occupations, our findings may potentially be extrapolated to larger groups of working class employees.

Our findings relate to a large literature concerned with crowding-out in retirement savings, see Bernheim (2002); Poterba et al. (1996) for thorough reviews, and more recently, Chetty et al. (2014) who, as noted, demonstrates almost full pass-through from savings in employer-provided pension accounts to total individual savings. However, as pointed out decades earlier by Engen et al. (1996), the effectiveness of retirement savings might be systematically overstated because savers potentially increase debt to offset an increase in pension contributions. Saving

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<sup>1</sup>See e.g. King and Levine (1993); Levine (1997); Eggertsson and Krugman (2012); Jorda et al. (2013); Mian et al. (2013); Andersen et al. (2016)

<sup>2</sup>Household debt is typically higher in countries with privately funded pension systems (Scharfstein, 2018).

and tax incentives for saving in retirement accounts could also increase pension savings (Duflo et al., 2006; Engelhardt and Kumar, 2007). However, these retirement policies seem ineffective to increase total savings because savers fully offset the increase in pension savings by adjusting non-retirement savings, including debt repayments (Andersen, 2018). In this paper, we hypothesise that savers, in a similar fashion, increase borrowing when being forced to save in mandatory pension plans. Clearly, this is an important question to answer when assessing the overall effectiveness of occupational pension schemes, but such behaviour could also explain, at least in part, how countries with well-developed pension systems also see increasing levels of household debt.

One paper that is closely related to our work is Beshears et al. (2019). They provide a natural experiment using the introduction of automatic enrolments into pension plans for employees in the US army. They find that mortgage debt growth does not change despite the fact that pension contributions rise. There are two distinct differences in their empirical test compared to our analysis. First, they evaluate the behavioural response to occupational pension schemes with an opt-out. The retirement policy that we evaluate in this paper is strictly mandatory with no possibility of opting out. Second, we examine a sample of savers in the lower end of the income distribution and with limited savings in non-retirement accounts. These savers are likely to be more constrained in terms of access to liquidity compared to savers examined in earlier studies. In other words, we find it more likely that liquidity-constrained savers respond to mandated retirement savings policies by increasing debt compared to similar, but unconstrained savers.

To the best of our knowledge, our paper is the first to provide empirical evidence on crowding-out in retirement accounts using third-party reported information about both financial assets and liabilities at individual level. We combine a broad set of administrative records from Denmark to provide almost full data coverage of the financial household balance sheet. Wealth information covers financial wealth, housing assets as well as debt in banks and mortgage credit institutions for each individual in 2015. Using unique identifiers, this information is merged on a panel with pension contributions, income, employment information, family compositions and personal characteristics from 1995 to 2015. Together, the data provides up to 20 years of evidence on the response to variation in mandatory pension contributions, an almost ideal laboratory to investigate the long-term effects of retirement policy instruments.

We exploit time variation in the introduction of mandatory pension contribution rates that

follows from the institutional settings in Denmark. Mandatory contribution rates were phased in earlier in public sector jobs than in private sector jobs with similar job content. The obvious confounding factor is that people with higher taste for saving are likely to select jobs with higher pension contribution rates (Gelber, 2011)—in this case, public sector jobs. Measuring direct differences in pension wealth and debt developments for public sector employees relative to their private sector peers seems insufficient to identify a causal relationship. To overcome the threat of endogeneity, we sample a pool of savers who have been employed in both sectors in identical occupations for a number of years. This sampling process is based on information about members in one of the largest pension funds in Denmark, which covers occupations for which the share of organised employers and employees is very high. This ensures that observed differences in pension contribution rates between individuals working in the public and private sector are indeed due to differences in mandatory pension contribution rates and not a result of individual negotiation or savings preferences. Based on the membership information from the pension fund and in order to obtain a sample of savers who are almost evenly distributed between public and private sectors, we select employees in cooking, waiting and cleaning services. We argue that preferences for saving, and e.g. aversion towards holding debt, are identical for all savers, on average, in our sample because they work in similar occupations and have all been employed in both sectors during their career.

For each individual, we observe employer-provided pension contributions in each year that they were employed in the public sector. At the same time, we calculate a counterfactual of contributions had they worked in the private sector instead during the same time period. The difference between these two numbers tells us to what extent each individual was additionally exposed to mandatory pension contributions in each year as a consequence of working in the public sector in that year. By stacking this amount over the sample period, we obtain a monetary measure of the 'excess' exposure to mandatory pension plans for up to 20 years at individual level, which we use as an instrument for pension wealth in a two-stage-leasts-squares regression setup.

The results show that total debt increases by 26 cents for each 1-dollar increase in pension wealth, an effect mainly driven by an increase in mortgage borrowing. Using a similar empirical model, we find an increased propensity to use interest-only mortgages of 2.8% for each 10% increase in pension wealth. By splitting the sample by age and liquid wealth, our analysis implies that the debt increase is larger for younger savers with limited access to liquidity. This indicates

that provision of liquidity is an important motive for increasing borrowing when mandatory pension contributions rise. We find no significant changes to savings in non-retirement accounts and by taking all financial assets and liabilities into account simultaneously, we document an overall crowding-out in retirement accounts of 24%.

The contribution of our paper is threefold. First, we track how both assets and liabilities at individual level are affected by a change in retirement policy. Unlike earlier studies, this provides an almost complete picture of employees' behavioural response to mandatory pension contributions. Second, our administrative records span over two decades. This is particularly useful since debt accumulation could happen slowly over time or with substantial delay after e.g. job changes, home purchase or family events such as divorce or child-birth. Third, we use variation in mandatory pension contribution rates in employer-provided pension plans. Unlike automatic enrolments to retirement schemes, in which savers can opt out, our setup provides important evidence about the response to savings mandates with no possibility of exiting the retirement scheme. The distinction between automatic enrolment and mandatory contribution is, of course, crucial for policy designs. Despite the fact that our results pertain only to the group of savers investigated—a relatively low income group with limited liquid wealth—this paper offers insights into an important policy question for which earlier research provides no or very limited empirical evidence.

The next section explains the Danish occupational pension system and outlines the source of variation used for identification. In section 3, we describe the data set, section 4 presents the empirical model, section 5 shows our results and a range of robustness analyses and finally, section 6 concludes.

## 2 Institutional settings

### 2.1 Pensions

The Danish pension system is composed of three pillars; (1) universal state pensions, (2) occupational pensions, and (3) private pensions. The state pension is of a defined benefit-type, while the two latter categories are defined contribution types.<sup>3</sup> Total contributions for the defined

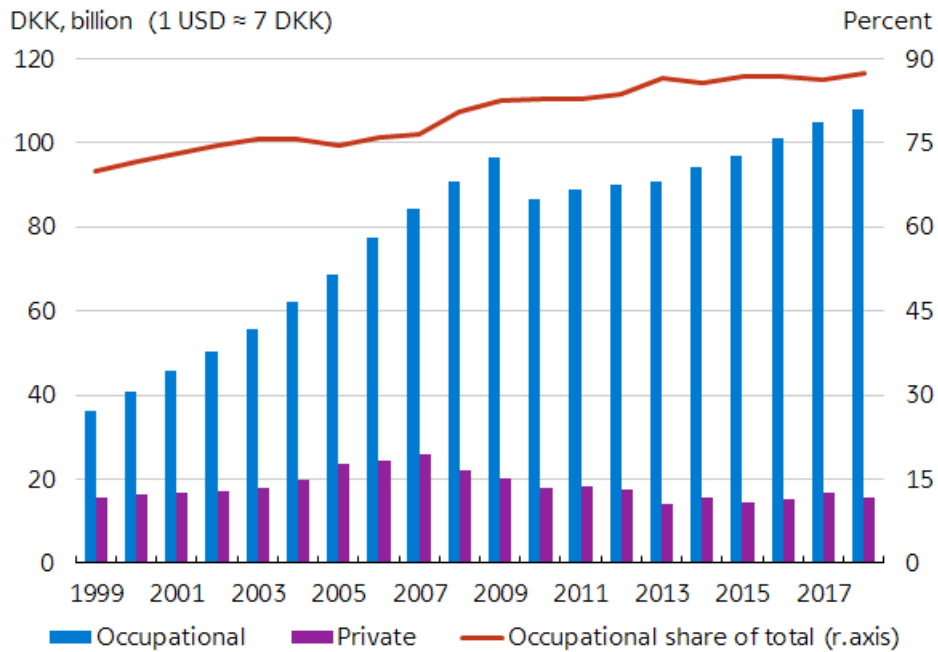
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<sup>3</sup>The first pillar represents public pensions provided by the state (i.e. tax-financed) with an aim to avoid poverty among elderly people by ensuring a sufficient income to everybody after retirement. It comprises a basic



contribution scheme types corresponded to 6% of GDP in 2018. Figure 1 presents contributions for pillars two and three, showing that occupational pensions constitute an increasing share and covered almost 90% of total contributions in 2018. In terms of magnitude, employer-provided retirement schemes have by far the largest impact on individual savings decisions in Denmark.

Figure 1: Pension contributions in Denmark



**Notes:** The bars measure total contributions for pillar (2) occupational pensions and pillar (3) private pensions in Denmark.

**Source:** Insurance and Pension Denmark.

The second pillar is comprised of occupational pension schemes where employers make monthly contributions to employees individual pension accounts. The aim is to facilitate consumption smoothing by ensuring a certain replacement ratio irrespective of the income level. Occupational pension schemes have existed in the public sector since the 1950s. In the late 1980s, mandatory pension schemes were introduced for all workers covered by collective labour market agreements, i.e. social contracts. These agreements specifying, *inter alia*, pension contribution rates are normally negotiated every second or third year. Social contracts cover the entire public sector and 50–75% of workers on the private labour market. The first occupational pension plans were introduced in the private sector in 1992–93, typically with a contribution of 0.9% of gross income, while contribution rates were 6% in the public sector. Contribution

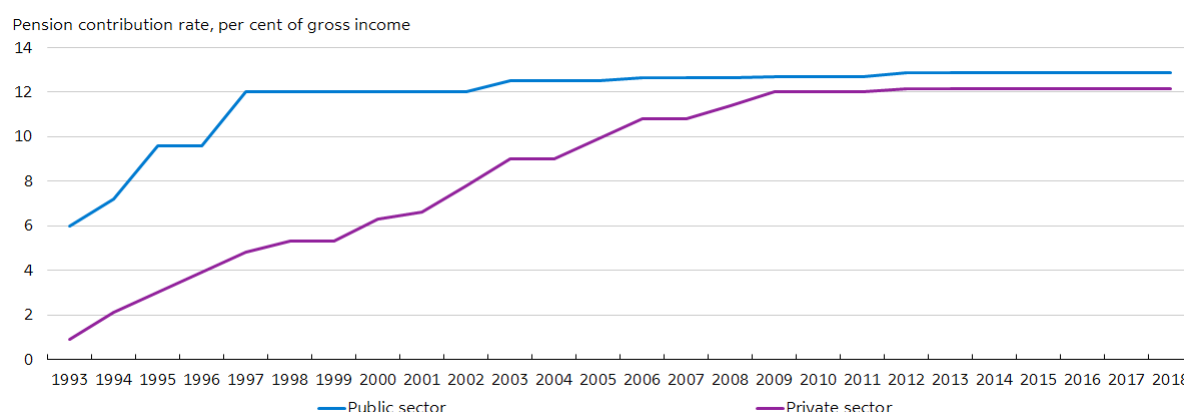
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pension for people above the statutory retirement age, as well as a supplementary pension subject to earnings testing.

rates increased markedly through the 1990s and early 2000s. Current levels were reached in about 2008–09, typically around 12% among blue collar workers, and up to 18–20% for white collar workers. The third pillar represents voluntary private savings schemes to allow for flexibility with respect to individual preferences for pension savings. These are independent from occupational pension schemes, although subject to the same favourable tax treatment.

One of the largest occupational pension providers in Denmark, PensionDanmark, mainly covers blue collar workers. Figure 2 presents pension contribution rates for contributors in this specific fund according to the collective agreements. Current levels of around 12% have been in place since 2009, and rates were clearly increased earlier for public sector employees than for private sector workers. Despite the fact that this figure covers only a part of the labour market, it provides a fair representation of how the occupational pension system was introduced more broadly in Denmark.

Figure 2: Pension contribution rates according to collective labour market agreements between unions and employer associations



**Notes:** Agreed pension contribution rates between the Danish Trade Union Confederation and the Ministry of Finance (public sector) and the Confederation of Danish Employers (private sector), respectively. Contribution rates for the public sector have been adjusted for the fact that officially agreed pension contribution rates apply to only a part of the total salary. The graph presents rates for members of PensionDanmark.

**Source:** PensionDanmark.

## Collective labour market agreements

Pension contributions constitute a substantial share of total compensation for employees in occupations covered by collective labour market agreements. These agreements are renegotiated at regular intervals to ensure that interests of both employers and employees are satisfied. The

negotiations are handled by member associations on the workers' union-side and the employers' association-side. When these two parties have reached an agreement on salaries, pension contributions, vacation and other terms related to total remuneration, all members of the member associations vote in favour of or against the agreement. If an agreement is not reached, workers have the option to strike and employers to lock out employees. Ultimately, in the case no agreement can be reached, the government intervenes and decides on all terms. The Danish labour market model is, however, based on a long history of collaboration between the labour market parties with no or limited interference from the government.

The phasing-in of occupational pension contributions has been financed by an increase in gross wages over time. Disposable income has not been reduced in any of the agreements in order to fund increasing pension contributions. Savers may in some instances be able to increase contributions for their occupational pension schemes in excess of the rates dictated by the collective agreements. Changes to occupational pension contributions set by collective agreements happen without connection to eligibility for first pillar pension payments, i.e. state pensions. Therefore, the rise in mandatory pension contributions observed in our data cannot be caused by substitution between first and second pillar schemes as documented by Lachowska and Myck (2018).

## **Flexible mortgage credit system**

The Danish mortgage system is not very different from systems in many other countries, including the US, as it provides long-term financing for housing through adjustable and fixed-rate loans.<sup>4</sup> However, there are a few key differences between mortgaging in Denmark and mortgage systems in other countries. First, the Danish system is widely used by the population as total mortgage lending exceeds 120% of GDP. More than half of the Danish population are homeowners and more than two thirds of these are mortgage borrowers.

Second, mortgages are provided by mortgage credit banks specialised in facilitating real estate loans. When borrowers are granted a mortgage loan, the mortgage credit bank issues corresponding mortgage bonds in the capital market. Payments from borrowers to mortgage bond holders are balanced such that mortgage credit banks hold no credit risk. Like commercial

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<sup>4</sup>Additional details regarding the Danish mortgage system can be found in Andersen et al. (2015) and Kuchler (2015).

banks, mortgage banks must meet e.g. capital requirements as well as organisational and managerial requirements. Furthermore, mortgage banks are subject to a number of specific rules on risk management, bond issuance, property valuation, registration of the collateral and liabilities, etc. Most loans are issued as 20 or 30-year loans, and there is a fixed LTV limit of 80 per cent of the initial value of properties used as permanent residences – the remaining (less secure) part of the funding may be provided by commercial banks. Mortgage banks screen borrowers based on their ability to service their debt and based on the value of the property. Interest rates are determined by market interest rates at the time of loan origination, and all borrowers that have chosen the same loan typology will be subject to the same interest rate.

Another key feature of the Danish mortgage system is the flexible access to mortgages with deferred amortisation. Interest-only mortgages gained rapid popularity since the introduction in 2003 and constituted more than half of the outstanding mortgage value in 2013. Amortisation on this loan typology can be deferred for up to 10 years after origination. Once a mortgage loan application is granted by the bank, borrowers can choose between typologies with or without immediate amortisation. This enables Danish homeowners to reduce or delay mortgage repayments for a longer period of time. In more recent years, macroprudential measures limiting the access to interest-only and/or variable interest rate mortgages have been put in place. But in our sample period, borrowers could freely choose loan typology.

Finally, an important feature of the Danish mortgage system is the borrowers' right to repay their mortgage at any point in time. The borrower can buy back the underlying bonds on his or her mortgage from the investor at par. This implies that borrowers can economise on an interest rate drop by repurchasing the bonds on their existing mortgage using the proceeds from a new fixed rate mortgage. By doing so, they will lock in the new, lower mortgage rate. Such refinancing activity also takes place when mortgage rates increase. In that case, borrowers will incur higher interest payments, while their remaining mortgage debt will be lower. Refinancing of fixed rate mortgages are thus common in times of interest rate volatility. Moreover, refinancing often takes place when borrowers intend to withdraw home equity or invest in e.g. home improvements. There are some fixed costs associated with loan refinancing, but in general, homeowners who intend to adjust their mortgage loan balance have relatively good opportunities to do so at regular intervals.

### 3 Data

We use a highly detailed panel dataset based on administrative registers from Denmark collected by Statistics Denmark and Danmarks Nationalbank. We use annual information about occupation, sector, income, and pension contributions in the period 1995–2015. The employment register includes end-of-year occupation type information according to the International Standard Classification of Occupations (ISCO). These data are combined with detailed balance sheet data containing information on mortgage debt, non-mortgage debt, as well as savings in banks, stocks and bonds. The balance sheet data are available for 2015 and provides the key outcome variables for the empirical analysis. The administrative records about income, wealth and debt are detailed and reliable as the information is reported by third parties, e.g. banks, mortgage banks and employers, often for tax purposes. This means that the information is audited with no risk of self-reporting bias.

Apart from the administrative registers, we have access to an employment classification of the members in one of the largest pension funds—and the largest occupational pension fund—in Denmark, PensionDanmark. Their members cover mainly blue collar workers working within e.g. transportation, hotel and restaurants, cleaning and construction as well as workers in local public administrations at municipal and regional level. PensionDanmark classifies their members in job categories directly based on the collective agreements for each job. We count the members in each employment classification and across the official industry codes, the latter according to Statistics Denmark. This matrix allows us to calculate which occupation types are almost equally represented in public and private sectors. Furthermore, all members in this pension fund are subject to the collective labour market agreements, implying that their pension contribution rates follow those depicted in Figure 2.

The sampling process is crucial to our identification strategy, and therefore very transparent. First of all, we need savers to be evenly distributed in the public and private sector and we need savers employed in occupations that are covered by the collective agreements. To achieve this, we include all individuals that have been employed in waiting, cooking and cleaning services for at least five years in the period 1995–2008. According to PensionDanmark’s members’ information, 59% of the fund’s public sector employees and 41% of their private sector employees are employed in these particular occupations. Classifications by the pension fund do not directly link to ISCO classifications in Statistics Denmark’s microdata. However, we sample the job descriptions by

ISCO codes in order to construct a data set of savers where the pension fund’s job descriptions are linked as closely as possible to the ISCO code job descriptions.<sup>5</sup> By doing this, we obtain a sample of individuals who are most likely to be covered by the collective agreements (see Figure 2) and who are well-represented in both the public and private sector within identical occupations.

To ensure that savers are in fact exposed to mandatory pension contributions, we restrict individuals in our sample to those that have had at least five years of employment in the selected job categories. Further, we restrict the sample to those who have had at least one year of employment in the public sector and at least one year in the private sector. We do this to make the savers in our sample as comparable as possible in terms of unobservable characteristics such as savings preferences, risk preferences and debt aversion. Public sector workers might differ from private sector employees on a set of both observable and unobservable characteristics. One could argue that workers with a high taste for saving might select into public sector jobs simply because of the higher pension contribution rates. Moreover, public sector jobs are likely to be less correlated with business cycles than similar jobs in the private sector and therefore provide a higher degree of job security. This implies that more risk averse workers might select public sector jobs rather than positions with identical job content in the private sector. For these reasons, comparing the saving behaviour of public versus private sector workers directly seems insufficient to overcome the threat of endogeneity—even conditional on occupation, age, work experience and other observables. By imposing the restriction of having been employed in both sectors, the sample size is reduced considerably. Finally, we exclude individuals that are in the top or bottom 1% of all outcome variables to reduce noise from extreme observations. Our sample contains 15,304 individuals with non-zero pension wealth in 2015.

Descriptive statistics for these individuals are reported in Table 1. The sample contains 89% women with an average age of 53 years by 2015. Six in 10 are married and two in 10 are renting their home. The average labour market tenure is 19 years and 14% are retired by 2015. 54% of those who have had a mortgage had an interest-only mortgage at some point during

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<sup>5</sup>Individuals are classified based on their primary job in the last week of November. Job functions are classified by the DISCO code, the Danish version of the ISCO classification. We include in our sample all individuals that have been employed within the following DISCO-88 codes for at least five years between 1995 and 2008: Cooking etc. (512200), Waiter (512300), and Cleaning (913000, 913200, 913210, 913220, 913230, 913245, 913260, 913270, 913300).

2009–2015 and 64% had an adjustable rate mortgage at one point during that same period. The mean income before taxes is DKK 270,000, corresponding to about the lowest quartile in the income distribution of married women in Denmark. Average mortgage debt and housing wealth are DKK 250,000 and 350,000, respectively, implying a loan-to-value of little more than 70%. Assets in stocks, bonds and bank deposits are DKK 120,000 in total, while non-mortgage debt is DKK 115,000. The latter covers both collateralised loans, e.g. financing for housing that exceeds the LTV threshold of 80%, and revolving credits in banks. Finally, the average pension wealth is DKK 408,000, corresponding to about USD 60,000.

Table 1: Descriptive statistics

	Mean	SD	1st quartile	Median	3rd quartile	N
Pension assets	408,176	210,116	257,065	373,861	524,661	15,304
Assets	112,338	194,443	13,570	33,341	116,506	15,304
Housing	351,279	477,777	0	0	650,000	15,304
Other debt	115,287	173,667	0	38,030	168,927	15,304
Mortgage debt	249,888	365,829	0	0	475,330	15,304
Income	269,837	98,384	202,147	271,678	324,397	15,304
Labour market experience (years)	19.37	3.91	17.00	21.00	23.00	15,304
Age (years)	52.93	10.66	44.00	53.00	62.00	15,304
Female	0.89	0.31	1.00	1.00	1.00	15,304
Married	0.61	0.49	0.00	1.00	1.00	15,304
Retired	0.14	0.35	0.00	0.00	0.00	15,304
Renter	0.19	0.39	0.00	0.00	0.00	15,304
Has (had) IO loan	0.54	0.50	0.00	1.00	1.00	9,110
Has (had) variable rate loan	0.63	0.48	0.00	1.00	1.00	9,110

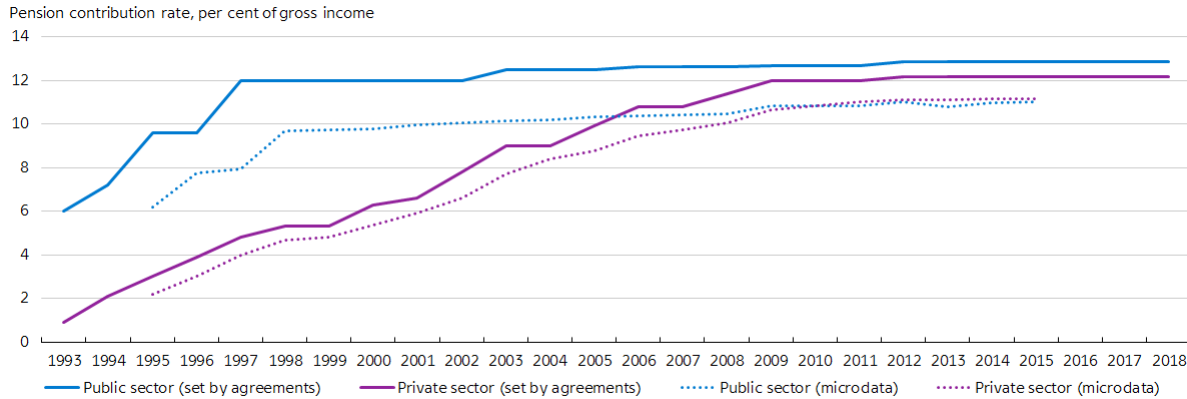
**Notes:** Monetary variables are measured in 2015 and all wealth information is reported after taxes at individual level.

**Source:** Own calculations based on register data from Statistics Denmark.

Based on the administrative registers, we define the individual pension contribution rate as the ratio of employer administered pension contributions to total gross wage income. Figure 3 shows pension contribution rates for occupational pension schemes in the public and private sector during 1995–2015, where solid lines are rates according to the collective agreements and dotted lines represent calculated rates in our sample. Our estimated pension contribution rates

based on the administrative registers mimic quite well the rates officially agreed between workers' unions and employers' associations shown in Figure 2.<sup>6</sup> Particularly, the wedge between the two sectors in the first half of the sample period stands out clearly. This indicates that the sampling process to a large extent includes savers with occupational pension contribution rates that follow actual agreements.

Figure 3: Pension contribution rates according to collective agreements and microdata



**Notes:** Solid lines are identical to those presented in Figure 2, showing occupational pension contribution rates according to the collective agreements. Occupational pension contribution rates are shown for employees in the public sector (blue dotted line) and the private sector (purple dotted line), according to administrative registers.

**Source:** Own calculations based on register data from Statistics Denmark.

## 4 Empirical Strategy

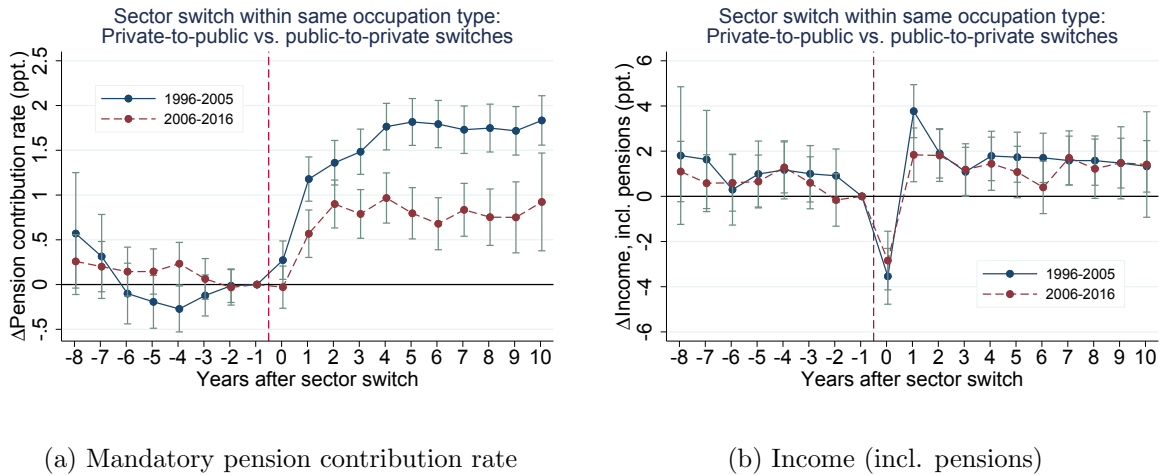
Our empirical strategy relies on the fact that mandatory pension contribution rates were introduced earlier for public sector employees compared to their private sector peers in similar occupations despite the fact that the development of total compensation over time has been similar for the two sectors (see Figure 8 in the Appendix). The sample of savers includes only employees who have worked in both sectors and for whom we have access to detailed information about employment and pension contributions at individual level. The direction of sector switches is almost evenly distributed, with 52% of the switches being from private to public sector. The different speed at which contribution rates were phased in implies that savers who switched from private to public sector within the same job type early in this time period expe-

<sup>6</sup>Differences in levels are caused by the fact that wage information in the microdata include e.g. bonuses, holiday allowance and other special payments which are excluded from the amount that is used by employers to calculate pension contributions.



experienced significantly larger jumps in mandatory pension contribution rates compared to similar switches later in time. Figure 4a shows exactly this pattern. The vertical axis counts the years since the sector switch and the horizontal axis measures the percentage point change in mandatory pension contribution rates. The blue line covers sector switches in 1996–2005 and the red line covers sector switches in 2006–2016. Both lines are not significantly different from zero for up to eight years before the switch. This parallel trend in contribution rates indicates that employer-provided pensions did not grow at different paces prior to the sector switch in either time period considered. After the switch, contribution rates increased permanently by 1.5 percentage points in 1996–2005 and 0.5 percentage points in 2006–2016 on average. In other words, earlier switches from private to public sector led to a 1 percentage point larger increase in mandatory contribution rates than a switch from public to private sector, compared to sector switches that happened later in time.<sup>7</sup>

Figure 4: Changes around timing of a sector switch within the same occupation



**Notes:** The figures show how mean pension contribution rates and gross income develop across the timing of a sector switch at time zero. The blue line covers the years 1995–2006 and the red line covers 2006–2016. The figures present coefficients in a fixed effects regression model. See Appendix for more information. Confidence bands illustrate statistical uncertainty at the 5% level, and standard errors are clustered at individual level.

**Source:** Own calculations based on register data from Statistics Denmark.

Total compensation for the two groups, however, remained unchanged from before to after

<sup>7</sup>We have also made the same calculations for total pension contributions, i.e. the sum of mandatory contributions for employer-provided schemes and voluntary contributions for private pension plans, and plotted them in Figure 6 in the Appendix. The pattern is almost identical to that of Figure 4a, indicating that increased savings in employer-provided pension accounts are not crowded out by a fall in contributions for private retirement accounts; an observation consistent with the findings in Chetty et al. (2014).

the sector switch. This is illustrated by Figure 4b. Income, including pensions, increased by around 2% each year—except from the years directly affected by the job change—and this is evident for both earlier switchers (blue) and later switchers (red). Together, these illustrations support the idea that the timing of introducing mandatory contribution rates is potentially a useful source of variation for identifying other behavioural responses. We have carried out similar event studies using savings in non-retirement accounts, debt and housing assets (Figures 6a–6d in the Appendix). All figures present parallel pre-trends in these outcomes when comparing early and late sector switches. Together, this implies that the observed variation in employer-paid pension contribution rates across time, illustrated by the wedge between public and private rates in Figure 3, is not generated by selection bias but is rather the result of the institutional settings in the Danish pension system. The next step in our analysis is to quantify this wedge.

For each individual, we accumulate the amount of extra savings in employer-provided pension accounts from years in public sector employment. To be more specific, this amount, which we will denote *Exposure* or  $E_i$ , is calculated as

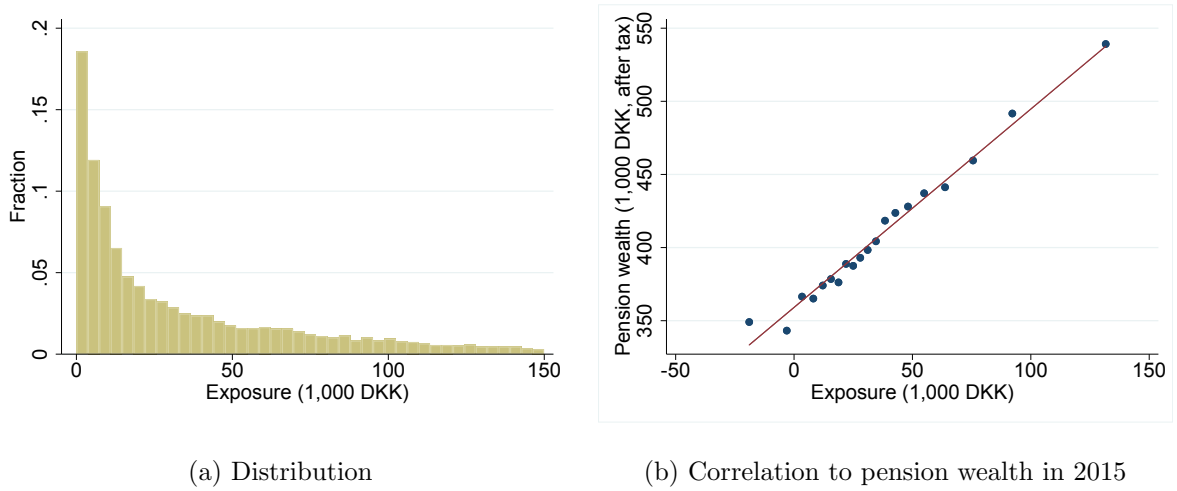
$$E_i = 0.6 \times \sum_{t=1995}^{2008} D_{it}^{pub} \times (p_{it} - p_t^{pri}) \times w_{it} \times (1 + r)^{2015-t} \quad (1)$$

where  $D_{it}^{pub}$  is an indicator variable taking a value of 1 if individual  $i$  is employed in the public sector in year  $t$  and 0 otherwise. The occupational pension contribution rate,  $p_{it}$ , is measured for each person  $i$  in year  $t$  and  $p_t^{pri}$  is the median pension contribution rate for employees in the private sector. The latter measures the alternative rate obtained in the private sector in that same year. Finally,  $w_{it}$  is the wage income of individual  $i$  in year  $t$ , and  $r$  is the assumed rate of return on pension wealth which is used to transform pension contributions in different years into 2015 values. In our baseline results, we use  $r = 0.05$ . In our robustness section, we show that the results do not change significantly when changing this rate of return. The exposure measure is multiplied by 0.6 to obtain after tax values consistent with the measurement of total pension wealth and debt.

Our empirical setup aims for comparing savings and borrowing responses of savers who are close to identical in terms of preferences for saving, occupation and employment history, while the only thing that makes them different is how much their employers forced them to save in retirement schemes out of their gross income. The identifying assumption pertains to the idea that deep parameters such as savings and risk preferences are assumed to be constant over time and likely to be identical for workers who have shifted from private to public sector employment

with identical job content or vice versa during 1995–2008. Conditional on the number of years of experience in each sector, we argue that the difference in exposure to mandatory pension contributions across calendar years is orthogonal to the savings behaviour of each worker. In other words, we assume  $E_i$  is correlated to the size of savers’ individual pension balances but uncorrelated to how they save in non-retirement savings vehicles and to how they borrow. Figure 5a presents a histogram of  $E_i$ . The mean is little above DKK 35,000 and the median is DKK 18,000. On average, exposure constitutes almost 10% of total pension wealth by 2015 in the sample, a substantial part of the total pension wealth accumulated by the savers across the sample period of up to 20 years.

Figure 5: Constructed measure of exposure to mandatory pension contributions



**Notes:** The exposure measure is constructed by stacking individual contributions for occupational pension accounts in years with public sector employment minus median contributions in private sector for similar jobs in that same year during 1995–2008, as per equation (1). The left-hand side shows the distribution of exposure across individuals in the sample. The right-hand side shows how the exposure measure is positively correlated to total pension wealth by 2015. This graph shows average pension wealth within each of the equally sized bins on the x axis, while controlling for the control variables from equation (2) (see notes to Table 2) .

**Source:** Own calculations based on register data from Statistics Denmark.

#### 4.1 Regression model

Ultimately, our aim is to identify the effect of pension wealth on debt. For this purpose, our measure of exposure to mandated pension savings is used as an instrument for pension wealth. Figure 5b shows that  $E_i$  is very closely correlated with pension wealth at individual level. The figure shows a positive relationship between the exposure to ‘excess’ mandatory pension contributions, accumulated during 1995–2008, and total pension wealth in 2015. The red line

is a linear regression fitted to the binned scatter plot with  $R^2 = .59$ . The slope is 1.36, which is significantly different from zero with  $p < 0.01$  (See Table 6, column 9, in the Appendix). This coefficient being significantly larger than 1 indicates that for each 1 dollar of extra savings in occupational pension schemes, the pension balance increases by 1 dollar and 36 cents up to 20 years later. The exposure measure is based on an assumed annual capital return of 5%, so additional capital gains in excess of 5% explains the 36 cents of extra savings. However, we cannot rule out that savers make additional savings in pension accounts once their employer enforces the savings mandate. Gelber (2011) finds a crowd-in effect in retirement savings, implying that savers start to save more once they are introduced to employer-provided retirement schemes. This is possibly explained by increased awareness of the possibility of saving in pension accounts or a decrease in transaction costs in terms of one-off administrative entry costs.

$$P_i^{2015} = \alpha + \delta E_i + \beta X_i + \varepsilon_i \quad (2)$$

Equation (2) is the first stage in our two-stage-least-squares regression model where  $P_i^{2015}$  is total pension wealth measured after taxes for individual  $i$  in year 2015.  $E_i$  is the exposure measure explained above, and  $X_i$  is a vector of control variables. First,  $X_i$  contains a number of covariates measured in the first year that the individual appears in the sample (1995 for most individuals in the sample), including income, housing wealth and financial assets. We also include dummies for each municipality at the first appearance in the sample and an indicator for whether the savers have moved out of this municipality during the years that they appear in the sample. To account for the fact that individual savers may have increasing, unchanged or decreasing income paths, we include indicators for the income quartile measured both at the first appearance in the sample and in 2015. These indicators are also interacted to account for all possible combinations of income paths that each saver may take during the sample period. We include similar indicators for housing wealth and financial assets. In the robustness section, we elaborate on the different types of model specifications that we have tested. In addition, we include a number of indicator variables controlling for age, first year in the data sample, and number of years active on the labour market to account for life cycle effects. Also, the vector contains dummies for number of years employed in the public sector and number of years employed in the private sector, both within the selected occupations, to ensure that we compare savers with equal tenure in each sector. The vector also controls for being married to take

into account behavioural savings decisions that are linked to the partner’s holding of assets and liabilities.<sup>8</sup> Finally, we control for gender, higher education, self-employment, being retired and being a renter. Idiosyncratic errors are captured in  $\varepsilon_i$ .

In the second stage, total debt in 2015,  $D_i^{2015}$ , is regressed on total pension wealth, where the latter is instrumented by the exposure measure. The remaining specification is similar to the first stage. In addition to this regression, we perform similar estimations with savings in non-retirement accounts and housing assets as outcomes.

$$D_i^{2015} = \alpha + \gamma \widehat{P_i^{2015}} + \beta X_i + r_i \quad (3)$$

The parameter of interest is  $\gamma$ , which identifies the effect of increased pension wealth on debt accumulation under the assumption that  $E_i$  is a valid instrument, i.e. that it is relevant and exogenous. The F statistic associated with  $E_i$  in our first stage regression is 1504, so  $E_i$  is a very relevant instrument in the sense of Stock and Yogo (2005). We cannot test directly on the data whether the instrument is exogenous, i.e. whether  $D_i^{2015}$  and  $E_i$  are uncorrelated. The identifying assumption hinges on the argument that our instrument captures how public sector employment generates additional pension wealth accumulation, particularly early in our sample period, relative to retirement savings in the private sector for savers with identical job profiles, equally many years of professional experience in their job and equally many years of tenure in either sector. Based on this conditionally exogenous time variation together with a range of individual controls, we argue that debt in 2015 is only affected by the instrument,  $E_i$ , through savings in employer-provided pension accounts and not through some third factor. To support this argument, we have plotted total compensation for the savers in our sample period across years, split into public and private sector, in Figure 8 in the Appendix. The figure illustrates that the sums of wages and pension contributions develop almost identically over time for the selected job profiles in the public and private sector. As total remuneration is almost identical in the public and private sector we find it reasonable to assume that differences in other factors between the two sectors, e.g. productivity, abilities, or worker characteristics, were not important drivers behind the choice of workplace during the sample period.

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<sup>8</sup>We also estimate the model using household level outcomes to test whether the pension savings mandate is crowded out by the partner’s debt accumulation (see Table 5). This model is estimated with less precision, but supports our main findings as the coefficient is not significantly different from that in our main specification.

## 5 Results

The impact of an increase in pension wealth on non-retirement savings and debt is presented in Table 2. Column (1) shows that total debt was 26 cents higher for each 1 extra dollar of pension wealth. Columns (2) and (3) in Table 2 split total debt into mortgages and other debt, respectively, the latter containing revolving credit in banks, loans for cars and other consumer items. Also, this type of borrowing contains housing loans that cannot be covered by mortgage banks, i.e. borrowing above an 80% LTV threshold. These results clearly show that mortgage borrowing is the main driver of the overall rise in total debt. For each 1 dollar increase in pension wealth, mortgage debt increases by 21 cents and non-mortgage debt increases by 5 cents. There is no significant response to the change in non-retirement savings in column (4). By subtracting the change in total debt (1) from the change in financial assets (4), we obtain the overall crowding-out estimate in column (5), showing that total savings, including debt, decline by 24 cents for each 1 dollar increase in pension wealth. Finally, column (6) presents the change in the home value, for which pension wealth has no explanatory power. To sum up, savers increase debt when they are forced to make additional savings in occupational pension plans, but they do not invest in more real assets. The results indicate that employer-provided pensions are effective in raising overall savings at individual level as the pass-through from 1 extra dollar saved in retirement schemes is an increase in total savings of 76 cents.

To learn more about the mechanism explaining the adjustment through mortgage debt, we utilise loan level data on mortgage characteristics. Table 3 shows the results of estimating IV regressions similar to the baseline results from Table 2 using loan characteristics as outcomes.<sup>9</sup> To be more specific, columns (1)–(2) in Table 3 present estimates where the dependent variable is a dummy indicator for whether individuals have had an interest only (IO) loan during 2009–2015. Similarly, columns (3)–(4) use a dummy for having had an adjustable rate mortgage during that same period. The results indicate that interest only loans play an important role for the adjustment of debt levels in response to changes in savings mandates. A 10% increase in pension wealth led to a 1.5 percentage point increase in the probability of having had an IO mortgage in the period 2009–2015. The baseline probability of homeowners having had an IO mortgage in that same period is 54%, implying a 2.8% increase in the probability of deferring amortisation for

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<sup>9</sup>To facilitate interpretation, the results presented in Table 3 are from a linear probability IV model. Results using IV probit models are similar (not reported).

each 10% increase in pension wealth.<sup>10</sup> This finding underlines the importance of taking a long-term view when assessing the impact on debt of changes in mandated retirement savings. By deferring amortisation on mortgages, debt increase only to a smaller extent in the short run but when the value of deferred repayments are accumulated over many years, as in our specification, the impact is of course considerable under the assumption that deferred repayments are not fully used to repay non-mortgage debt or increase liquid savings. The increase in pension wealth did not lead savers in our sample to use adjustable rate mortgages to any larger extent. The parameters in column (3)–(4) of Table 3 are small and statistically insignificant. This supports our argument that savers that were differentially affected by mandatory pension contribution rates did not take on more or less risky loans, indicating that the research design manages to filter away individual differences in terms of attitudes towards risk.

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<sup>10</sup>Usage of interest-only mortgages in our sample does not depart substantially from the full population of Danish mortgage borrowers where about half defer amortisation (Andersen et al., 2020).

Table 2: IV regression results: Effect of pension wealth on assets and liabilities

	Debt	Mortgages	Other debt	Financial assets	Financial assets (net)	Housing
	(1)	(2)	(3)	(4)	(5)	(6)
Pension assets	0.261*** (0.051)	0.209*** (0.046)	0.052* (0.030)	0.025 (0.024)	-0.236*** (0.059)	0.059 (0.038)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,304	15,304	15,304	15,304	15,304	15,304
$R^2$	0.551	0.558	0.127	0.584	0.578	0.836

**Notes:** Robust standard errors in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Dependent variables are total debt (1), which constitutes mortgages (2) and other debt (3). Financial assets (4) include savings in stocks, bonds and bank deposits. Net assets (5) equal financial assets (4) minus total debt (1). Column (6) is the value of real estate owned. All figures are reported after taxes in 2015. Control variables include income, housing wealth, financial assets and municipality indicators measured in the first year that the individual appears in the sample, as well as indicators for change of municipality during the sample period, the income quartile both at the time the individual first appears in the sample as well as at the end of the sample, as well as their interactions. In addition, control variables include indicators for age, first year in the data sample, number of years active on the labour market, number of years employed in the public sector, number of years employed in the private sector, both within the selected occupations, marital status, gender, higher education, self-employment, being retired and being a renter. The parameters in the top row correspond to the parameter  $\gamma$  in equation (3). First stage regression results can be found in column (9) in Table 6 in the Appendix.

**Source:** Own calculations based on register data from Statistics Denmark.



Table 3: IV regression results: Mortgage loan characteristics

	Pr(Interest-only)		Pr(Adjustable rate)	
	(1)	(2)	(3)	(4)
Log(Pension assets)	0.092*** (0.031)	0.154*** (0.046)	0.041 (0.029)	0.050 (0.044)
Controls	No	Yes	No	Yes
Age FE	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes
Observations	9,110	9,110	9,110	9,110
$R^2$	0.078	0.110	0.072	0.100

**Notes:** Robust standard errors in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Dependent variables are dummies for having had an interest-only mortgage at one point during 2009–2015

(1)—(2), and similarly, having had adjustable rate mortgages at one point in time during 2009–2015 (3)—(4).

Parameter values are estimated in a linear probability model. Similar results are obtained using a probit model (not reported). Pension wealth is measured in log and the remaining specifications correspond to Table 2.

**Source:** Own calculations based on register data from Statistics Denmark.

## 5.1 Heterogeneity

We utilise the level of detail of the data and investigate heterogeneous responses to the increase in mandatory pension contribution rates. Table 4 presents estimates from the same model specification as described above but for different sets of subsamples. Columns (1) and (2) show the increase in debt for the younger half of the sample, where column (1) includes savers with below-median liquid wealth and column (2) includes savers with above-median liquid wealth. All criteria are measured in the first year that the savers appear in the data set. In a similar fashion, columns (3) and (4) present estimates for the older half of the sample, for savers with low and high liquid wealth holdings, respectively. The pattern points clearly to the existence of a liquidity effect, where younger, low wealth individuals, who are likely to be constrained, accumulate more debt as a response to the savings mandate. The increase in borrowing is stronger both quantitatively and in terms of statistical significance for younger and less liquid savers. We have also estimated models with net assets as a dependent variable (Table 7 in the Appendix) across these four subgroups. They show an identical substitution pattern, underlining that crowding-out in retirement accounts is substantial for savers, who are likely to be constrained in their access to liquidity.

## 5.2 Robustness

This section presents a range of robustness tests. All tests depart from the main specification of our empirical model but for various subsamples or input on the right-hand side, while the dependent variable is total debt in all cases. Column (1) in Table 5 estimates the main specification but with another definition of exposure,  $E_i$ . In the baseline model, we calculate exposure to mandatory pensions, as explained in eq. (1), based on observed contribution rates for occupational pension plans in years of public employment relative to the median of observed contribution rates in the private sector in that same year. To ensure that the latter rate is not a result of systematic bias, e.g. selection bias in job choice, we replace the median of observed contribution rates in the private sector with the rates dictated by the collective agreements, illustrated in Figure 3. The parameter is not significantly different from that of our baseline model, so we conclude that this type of potential threat to identification is not biasing our main results. Columns (2)–(3) in Table 5 use different input of the discount rate  $r$  into the calculation of  $E_i$  to test that the assumed annual capital return rate of 5% is not driving our results.

Table 4: Heterogeneity: Debt accumulation across age and wealth groups

	Younger, low wealth	Younger, high wealth	Older, low wealth	Older, high wealth
	(1)	(2)	(3)	(4)
Pension assets	0.434*** (0.121)	0.292*** (0.113)	0.163* (0.094)	-0.017 (0.080)
Controls	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes
Observations	4,270	3,652	3,434	3,948
$R^2$	0.632	0.610	0.504	0.462

**Notes:** Robust standard errors in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The dependent variable in all specifications is total debt. Columns (1)–(2) cover individuals in the sample below the median age cut-off and columns (3)–(4) include individuals of an age above the sample median. In a similar fashion, the sample is split into two equally sized groups based on the liquid wealth in the year in which the individual first appeared in the data. Columns (1) and (3) cover savers with little liquid wealth, while columns (2) and (4) cover those with liquid wealth above the median threshold. Remaining specifications correspond to Table 2.

**Source:** Own calculations based on register data from Statistics Denmark.

Each column shows that the estimated debt accumulation response to an increase in mandatory pension savings does not change significantly if we instead assume returns of 2% and 8%, respectively. We have also obtained an estimated return for each year  $t$  by PensionDanmark. These are not actual returns but rather calculated based on each year's return for aggregated asset classes in their members' portfolios. Using these numbers as input in our model does not change our estimates significantly as shown in column (4).

Columns (5)–(6) in Table 5 presents the main result when using an alternative measure of individual income. This measure captures the accumulated income over the available sample period for each saver, discounted by the consumer price index. In column (5), we remove the income quartile indicators from the regression and add the accumulated income measure as

control. In column (6), we use the accumulated income measure as control, while all other controls for income, financial assets and housing wealth are removed. In both cases, we find no significant changes in our main result compared to the baseline model specification. In column (7) in Table 5, we estimate the baseline model but omit the variables containing income, housing wealth and financial assets measured in the first year that each individual appears. Given the fact that individuals appear for the first time in the data during 1995–2004, there is up to nine years’ difference to when the first year income observation is measured. Omitting these first year observations from the specification does not change our results significantly.

Next, we turn to column (8) of Table 5 in which savers who have retired by 2015 are excluded from the sample. Given that they have reached retirement, they might have changed consumption and savings behaviour considerably relative to the time at which they were employed. They might already have liquidated assets and/or consolidated debt, e.g. through the sale of property or scaling down of housing costs. Exclusion of this group does, however, not change our main result. Column (9) in Table 5 presents the debt response to a sample of renters only. Given that the crowding-out response in our main specification is driven mainly by mortgage debt, we would not expect to see a significant parameter in this robustness test. Column (9) confirms this exactly. Finally, in column (10) in Table 5, we turn to a model specified with household-level debt on the left-hand side and similarly, household-level pension wealth on the right-hand side of equation (3). As described in section 4.1, we do this to ensure that debt accumulation determined at the level of the household is consistent with the estimated debt accumulation response at the level of the individual. This model is estimated with much less precision. However, the confidence band includes the estimates of our main specification. This confirms that our conclusions do not change when analysing the behaviour of households rather than the behaviour of individuals.

Apart from the robustness test explained above, we have also tested whether our results change significantly based on which control variables we include in the baseline specification. Table 6 in the Appendix presents the first and second stages, explained by equations (2) and (3), respectively, for stepwise inclusion of all control variables. Controlling for nothing else but years of employment in either private or public sector jobs, the main parameter of interest,  $\gamma$ , which measures the change in debt in case of a 1 dollar increase in pension wealth, increases to 57 cents. This indicates that our preferred specification could represent a lower bound to the borrowing response when mandatory pension savings increase. By adding only age dummies

in column (3) of Table 6 in the Appendix, we see that  $\gamma$  declines to 33 cents, a number not significantly different from our baseline result. The key takeaway is that, as long as we control for age, our results are not sensitive to the type of income and wealth controls that we have used in any specification of the model.

Table 5: Robustness: Effect of pension wealth on debt

	Agreed rates	2% return	8% return	Estimated return	Income 1995-2015	Income 1995-2015	No first year obs.	Excl. retirees	Renters	Household level
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Pension assets	0.251*** (0.053)	0.275*** (0.054)	0.234*** (0.050)	0.228*** (0.050)	0.224*** (0.058)	0.166*** (0.057)	0.266*** (0.048)	0.303*** (0.061)	0.111 (0.073)	0.790*** (0.239)
Age FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Move municipality dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income, first year	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Financial wealth, first year	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Housing wealth, first year	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Income, q <sub>t-n</sub> X q <sub>t</sub>	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Financial wealth, q <sub>t-n</sub> X q <sub>t</sub>	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Housing wealth, q <sub>t-n</sub> X q <sub>t</sub>	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Observations	15,291	15,287	15,319	15,291	15,233	15,233	15,304	11,246	2,876	15,222
R <sup>2</sup>	0.552	0.549	0.553	0.553	0.552	0.484	0.549	0.572	0.249	0.134

**Notes:** Robust standard errors in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The dependent variable is total debt. In column (1), exposure is measured based on agreed pension contribution rates in the private sector, instead of those observed in the sample. Columns (2)–(4) estimate the main specification with various assumptions for annual return on capital in 1995–2015. Column (2) assumes a fixed return of 2%, column (3) assumes a fixed return of 8% and column (4) employs estimated returns that varies for each year in the period 1995–2015, according to PensionDanmark. In column (5), the model includes an additional income control variable which accumulates all income from the first year that the saver appears in the data to 2015, discounted by the consumer price index. In column (6), the accumulated income measure is used as control, while all other controls for income, financial assets and housing wealth are removed. In column (7), we estimate the baseline model but omit the variables containing income, housing wealth and financial assets measured in the first year that each individual appears. Column (8) excludes individuals who received state pension in 2015 and column (9) estimates the main specification on those who did not own property in 2015. Column (10) estimates a model using dependent and explanatory variables at household level. Remaining specifications correspond to Table 2.

**Source:** Own calculations based on register data from Statistics Denmark.

## 6 Concluding remarks

We have used 20 years of individual level administrative data containing detailed information about savings and debt to evaluate the effect of mandatory pension contributions. By using longitudinal information from Danish administrative records about employment history and pension contributions at individual level, we have constructed an empirical research design in which causal relations between pension wealth and debt can be tested. The source of exogenous variation to mandatory pension contribution rates relies on the institutional settings in Denmark, as contribution rates were differentially introduced across sectors but within similar occupations.

Our results demonstrate that increasing mandatory pension contribution rates may cause an increase in debt in the longer run. The increase in borrowing is mainly driven by increased mortgage debt among young homeowners, and particularly so for young homeowners with limited savings in liquid savings accounts. This points to the conclusion that the increase in mandatory pension savings is possibly offset by an increase in mortgage borrowing to provide liquidity. We also find that the propensity to use interest-only mortgages increases significantly with the increase in mandatory retirement savings.

The results show a significant increase in mortgage debt by 21 cents, on average, for each 1 dollar increase in pension wealth. Non-mortgage debt is also increased, however only slightly, and the effect is measured with less precision. Savings in non-retirement savings accounts remain unchanged and we document a total crowding-out in retirement accounts by 24%. The findings imply that employer-provided pension schemes are effective in raising employees' overall savings as they only offset the savings mandate by about one fourth. More importantly, our results imply that estimation of the crowding-out effect strongly depends on being able to observe consumers' borrowing response to an increase in mandatory pension savings. When debt information, and in particular mortgage information, is not available, the crowding-out in retirement accounts is possibly overstated as most of the behavioural response is reflected by adjustments to mortgage borrowing.

A balance sheet expansion along the lines documented in this paper may potentially increase risks to the stability of the financial system as well as to macroeconomic stability. For example, households with higher levels of debt may be more exposed to interest rate risks and their consumption may be more volatile than that of less leveraged peers. There is a well-established

link between household debt and pension wealth across countries, but the underlying mechanisms are not fully understood. Our paper offers new insights into this relationship by demonstrating that an increase in mandatory pension contributions is likely to contribute to increasing debt levels in the long run.

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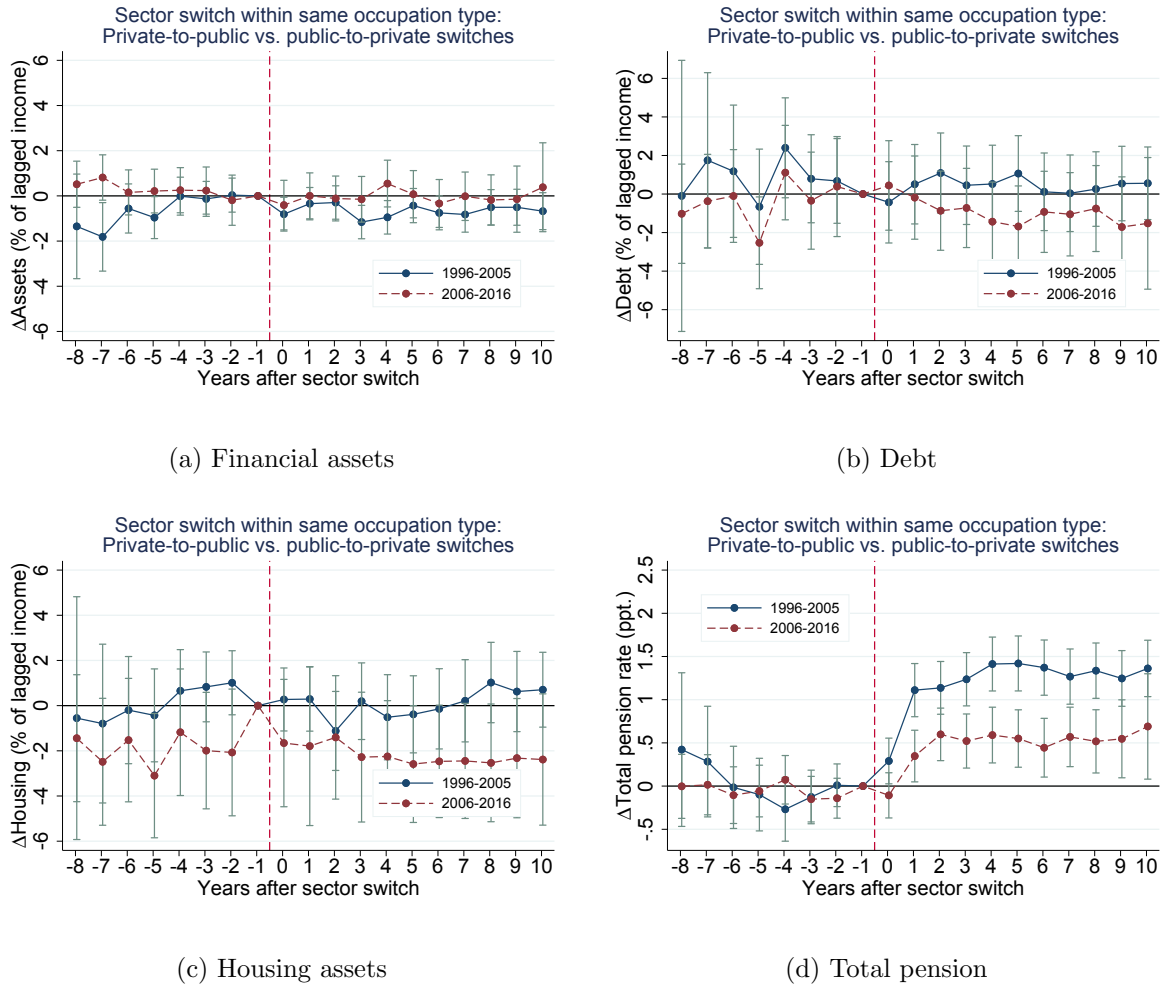
## A Appendix

Figures 4a, 4b, and 6 are constructed by estimation of the following specification, where  $\beta_t^3$  is plotted for  $y = (p^E, I, p)$ , respectively.

$$y_{i,t} = \alpha + \beta_t^1 group_i + \beta_t^2 etime_t + \beta_t^3 group_i \times etime_t + \gamma \Omega_i + \delta X_{i,t-1} + \varepsilon_{i,t}, \quad (4)$$

where  $p_{i,t}^E$ ,  $I_{i,t}$ , and  $p_{i,t}$  are occupational pension contribution rate, gross income, and total pension contribution rate, respectively, for individual  $i$  in time  $t$ . On the right-hand side,  $group_i$  divides the sample in two time periods, i.e. 1995–2005 and 2006–2015.  $etime_t$  counts the number of years after sector switch,  $\Omega_i$  captures time-invariant individual effects,  $X_{i,t-1}$  is a vector of lagged controls and  $\varepsilon_{i,t}$  are idiosyncratic errors.

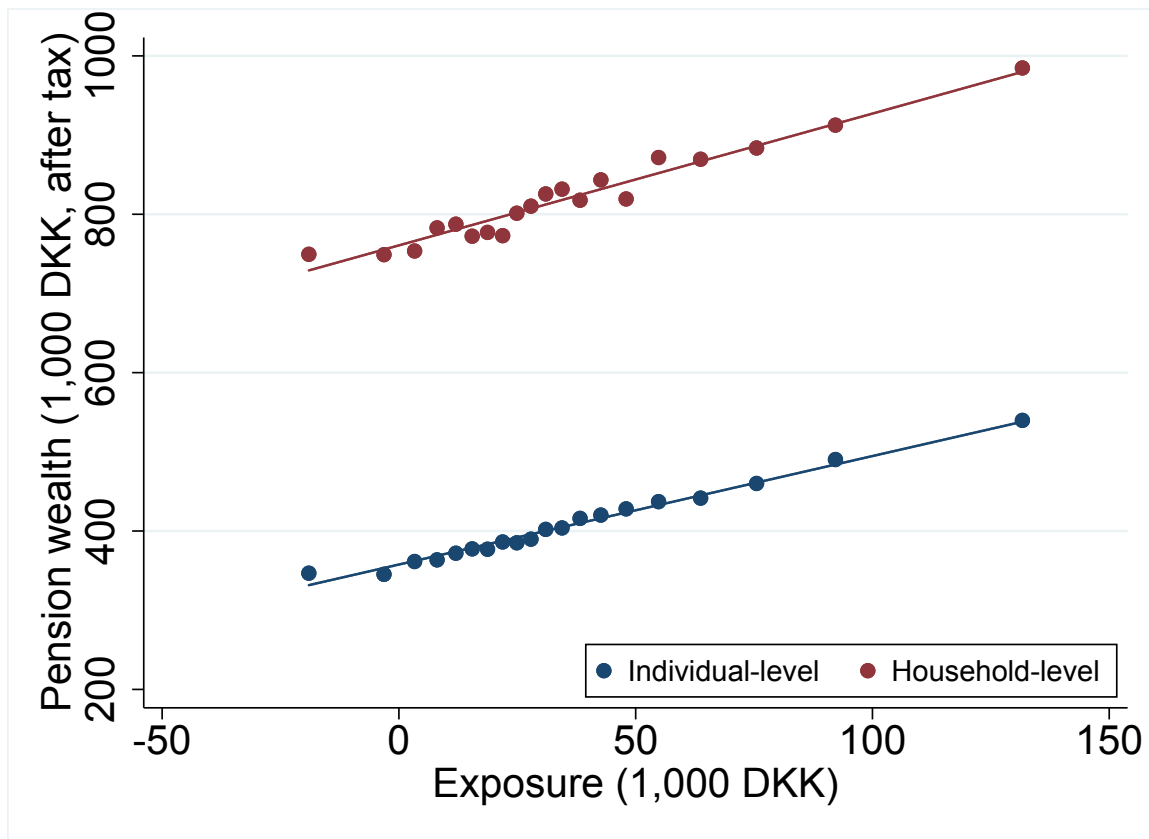
Figure 6: Changes around timing of a sector switch within the same occupation



**Notes:** The illustration shows developments in (a) financial assets, (b) debt, (c) housing assets and (d) total pension contribution rates, including contributions for both occupational schemes and voluntary contributions for private pension accounts. See notes to Figures 4a and 4b for further information.

**Source:** Own calculations based on register data from Statistics Denmark.

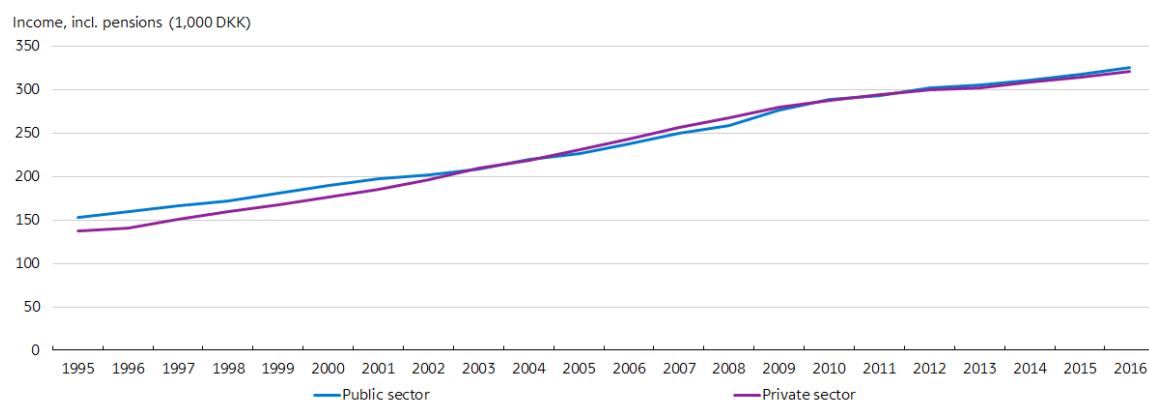
Figure 7: Correlation between exposure to mandatory pension accounts and total pension wealth



**Notes:** The graph is constructed as a binned scatter plot with each dot representing the average pension wealth within each bin. The blue dots represent pension wealth at individual level, corresponding to the illustration in Figure 5b. The red dots measure pension wealth at household level. Exposure is the measure of accumulated savings in mandatory pension accounts that each individual has saved due to public sector employment relative to what this person could have received in similar occupations in the same year in private sector employment.

**Source:** Own calculations based on register data from Statistics Denmark.

Figure 8: Total compensation (income, incl. pensions)



**Notes:** The graph is constructed by measuring median income, including pension contributions, in each calendar year for public (blue) and private (purple) sector workers.

**Source:** Own calculations based on register data from Statistics Denmark.

Table 6: Main results: IV robustness

	Pension	Debt	Pension	Debt	Pension	Debt	Pension	Debt	Pension	Debt
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exposure	1.991*** (0.039)		1.659*** (0.033)		1.655*** (0.033)		1.528*** (0.033)		1.356*** (0.032)	
Pension assets		0.565*** (0.049)		0.331*** (0.045)		0.303*** (0.045)		0.302*** (0.049)		0.261*** (0.051)
Age FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipal FE	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Move municipality dummy	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Income, first year	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Financial wealth, first year	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Housing wealth, first year	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Income, $q_{t-n}$ X $q_t$	No	No	No	No	No	No	No	No	Yes	Yes
Financial wealth, $q_{t-n}$ X $q_t$	No	No	No	No	No	No	No	No	Yes	Yes
Housing wealth, $q_{t-n}$ X $q_t$	No	No	No	No	No	No	No	No	Yes	Yes
Observations	15,304	15,304	15,304	15,304	15,304	15,304	15,304	15,304	15,304	15,304
$R^2$	0.241	.	0.505	0.446	0.519	0.469	0.550	0.475	0.587	0.551

**Notes:** The table presents estimates of the two-stage-least-squares model described in equations (2) and (3).

The columns fit together pairwise such that columns (1) and (2) represent one estimation of the two step model and so forth for the next columns. Columns (9) and (10) constitute our preferred specification used in the paper's empirical model described in section 4.1.

**Source:** Own calculations based on register data from Statistics Denmark.

Table 7: Heterogeneity: Net assets across age and wealth groups

	Younger, low wealth	Younger, high wealth	Older, low wealth	Older, high wealth
	(1)	(2)	(3)	(4)
Pension assets	-0.359*** (0.128)	-0.281*** (0.127)	-0.140 (0.105)	0.060 (0.099)
Controls	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes
Observations	4,270	3,652	3,434	3,948
$R^2$	0.627	0.619	0.526	0.524

**Notes:** Robust standard errors in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

The dependent variable in all specifications is net assets. Columns (1)—(2) cover individuals in the sample below the median age cutoff and columns (3)—(4) include individuals of an age above the sample median. In a similar fashion, the sample is split into two halves based on the liquid wealth in the year that the individual first appeared in the data. Columns (1) and (3) cover savers with little liquid wealth, while columns (2) and (4) cover those with liquid wealth above the median threshold. Remaining specifications correspond to Table 2.

**Source:** Own calculations based on register data from Statistics Denmark.

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