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ARTICLE

Mandatory pension savings and long-run debt accumulation: evidence from Danish low-wage earners

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Abstract

Based on two decades of Danish register data at the individual level, this paper finds that a 1-dollar increase in pension wealth leads to a 42-cent rise in total debt for a group of low-wage earners. Collective bargaining in the labor market provides time-sector variation in mandatory pension contribution rates, which we exploit in two empirical research designs; an event study and a cross-sectional instrumental variable regression model. Both methods demonstrate that the debt rise is accompanied by increased housing wealth and homeownership rates. Together, the empirical evidence indicates that mandatory pension contributions lead to a significant increase in net wealth, as well as in gross debt.

Key words: Pension wealth; Household debt; Household balance sheets

Many countries have seen a substantial increase in household debt over the past few decades, potentially affecting macroeconomic developments and financial stability.[1] Maturing funded pension plans are possibly playing a key role in explaining this increase in debt levels.[2] However, limited empirical evidence exists on how the introduction of mandatory pension contributions affects savings and borrowing decisions by households.

A recent study by Beshears *et al.* (2019) finds no significant change in debt growth when employees become automatically enrolled into retirement plans. Unlike them, we study the borrowing response to mandated pension contributions. This is similar to Chetty *et al.* (2014), who examine a large panel of savers exposed to different mandated pension contribution rates. Their research design does not, however, allow them to quantify a behavioral change in mortgage borrowing. Rather, they find that savings in taxable accounts remain almost unchanged in the event of an increase in occupational pension contributions.[3] To our knowledge, no evidence exists from settings in which adjustments to both debt and non-retirement savings have been tested simultaneously. Our paper aims to fill this gap. Moreover, the paper sheds light upon the behavioral response to mandatory pensions by a low-income group of wage earners and tracks the same individuals over a long period of time – both providing novel insights compared to earlier empirical work.

We use two decades of longitudinal data to measure changes in both financial assets and liabilities as mandatory contribution rates for employer-provided pension plans increase. We exploit the fact

[1]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).

[2]Household debt is typically higher in countries with privately funded pension systems (Scharfstein, 2018).

[3]Their work stands on an extensive body of research on crowding-out in retirement savings (Poterba *et al.*, 1995, 1996; Engen *et al.*, 1996; Bernheim, 2002; Attanasio and Rohwedder, 2003; Duflo *et al.*, 2006; Engelhardt and Kumar, 2007; Aguila, 2011), see also Arnberg and Barslund (2014); Andersen (2018); Lachowska and Myck (2018); Lefebvre and Perelman (2020).

that collective bargaining in the Danish labor market provides variation in employees' contribution rates depending on the timing of employment in different sectors. In order to use this source of variation in our identification strategy, it is necessary to limit the sample to a small selected group of low-wage earners with job functions within cooking, waiting and cleaning services. The sample is, nonetheless, representative of the general population of below-median wage earners in Denmark based on a broad set of observables.

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 the 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 to 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 provide up to 20 years of evidence on the response to variation in mandatory pension contributions.

Mandatory pension contributions were phased in earlier in public sector jobs than in private sector jobs with similar job content. However, 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. Obvious confounders are risk attitudes and savings preferences. Risk-seeking individuals may turn to private sector jobs, where earnings are more volatile, and people with higher preferences for saving are likely to select jobs with higher pension contribution rates (Gelber, 2011), in this case, public sector jobs. Moreover, income developments could differ across sectors. 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 remuneration, including pension contributions, is decided by collective agreements. The occupation information from the pension fund is important as it allows us to establish a sample of individuals from both private and public sectors for whom mandatory pension contribution rates are the result of collective bargaining and do not reflect individual negotiation or savings preferences. We argue that preferences for saving, and e.g., aversion toward holding debt, are likely to be 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 careers.

We exploit the time-sector variation in mandatory pension contribution rates in two very different empirical research designs: an event study and a cross-sectional instrumental variable (IV)-regression model. First, we utilize the panel structure of our data by applying an event study design that exploits the timing of switches between sectors. The idea is that, when switching from a private sector job to a similar job in the public sector, mandatory pension contribution rates increase, while overall remuneration remains unchanged. As we would expect, we find an increase in pension savings after such a switch, but this is accompanied by an increase in mortgage debt and housing wealth. We cannot reject that this pattern reflects a smoothing mechanism where savers increase borrowing to offset the pension savings mandate. However, the striking co-variation in mortgage debt and home values and homeownership rates indicates that the housing market plays a key role in explaining the interplay between pension wealth and debt accumulation. Pension wealth is proxied by accumulated pension contributions in the event-study design, so these results are only indicative of the actual crowding-out effects. In addition, it may be necessary to consider a longer time horizon than some years before and after sector switches since intervals between adjustments in debt levels may be long. We therefore turn to a cross-sectional regression model to quantify the crowding-out effects based on data on the full financial balance sheet for each worker, including pension wealth information.

Our cross-sectional IV framework utilizes that we have access to workers' employment histories from 1995 to 2015. 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 the individual level, which we use as an instrument for pension wealth, in 2015, in a two-stage least-squares regression setup.

The results show that total debt increases by 42 cents for each 1-dollar increase in pension wealth, an effect entirely driven by an increase in mortgage borrowing. At the same time, and consistent with the results from the event-study design, we find a significant increase in homeownership rates and housing wealth. This implies that rising pension wealth allows more workers to buy property or enables them to buy more expensive homes. One potential mechanism implies that banks and mortgage banks assign a non-zero weight to retirement wealth in their credit scoring processes. Retirement wealth cannot be posed directly as collateral for credit, but savings in funded pension schemes ensure a stream of income and higher replacement rates in retirement, which in turn allows borrowers to service their debt well into retirement. An alternative mechanism consistent with our results could be that workers increase their demand for housing as they accumulate pension wealth that ensures a steady stream of income in retirement. Our sample is quite representative for the low-income population in Denmark in terms of income, assets and debt levels. We therefore expect that our results will be more generally applicable also in other contexts. However, we do not know the extent to which factors such as credit availability, preferences and institutions are important for the external validity of our findings, and we therefore encourage future research in similar questions in other contexts.

The contribution of our paper is threefold. First, we provide greater data coverage compared to existing empirical contributions to this literature by tracking both assets and liabilities at the individual level, and by measuring behavior across two decades for each saver. This ensures an almost complete picture of employees' financial portfolio components. The long-term view is particularly important as debt accumulation may happen slowly over time or with substantial delay after, e.g., job changes, home purchase or family events such as divorce or child-birth. Second, we examine a group of individuals with relatively low earnings unlike other papers where research designs limit the conclusions to pertain only to middle- or high-income earners. Our setup unveils behavioral changes in the bottom of the income distribution and thus takes a step toward filling this gap in the literature. Third, our findings have important implications for 'nudges', mandates or defaults in pension policies, which have shown to be crucial predictors of savings outcomes (Madrian and Shea, 2001; Thaler and Benartzi, 2004; Chetty *et al.*, 2014). Policies that force or nudge savers into raising savings in retirement accounts are effective at increasing overall savings, possibly because many savers act by rule-of-thumb, i.e., they are passive savers. Little is known about the effect of such pension policies on household debt accumulation, which may have important implications for macroeconomic and financial stability. Our paper speaks directly to this question.

The next section provides details on our data, the context and outlines the source of variation used for identification. We then present our panel evidence on savings behavior around sector switches. The following sections discuss our IV results and a range of robustness analyses, whereas the final section concludes.

1. Institutional setting and data

The Danish pension system is composed of three pillars: (1) universal state pensions, (2) occupational pensions and (3) voluntary pensions. The state pension is pay-as-you-go with defined benefits, while the two latter categories are funded schemes with defined contributions.[4] Total contributions for the

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

defined contribution scheme types are substantial by international comparison, corresponding to 6% of GDP in 2018. Occupational pensions constitute an increasing share and covered almost 90% of total contributions in 2018.

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 labor market agreements, i.e., social contracts.[5] 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 labor 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 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.[6] Pension benefits are, with a few exceptions, taxed upon payout, as well as capital gains are taxed annually in the accrual period. The phasing-in of the occupational pension schemes has been financed mainly as a share of the agreed increases in gross wages over time. Disposable income has not been reduced in any of the agreements in order to fund increasing pension contributions. Hence, the costs of the phasing in of the occupational pension system are borne jointly by employers and employees.

The institutional setting in Denmark provides us with a useful framework for examining how increasing pension wealth interacts with savings in non-retirement accounts and debt. Cross-country evidence shows a distinct correlation between the size of the pension system and household debt (Scharfstein, 2018). Access to population-wide register data in Denmark enables us to demonstrate a similar pattern at the individual level. By plotting the mean debt-to-income ratio in 2015 over bins of the annual increase in pension contribution rates over 1995–2008, we clearly see a positive correlation in Figure 1. This implies that gross debt is associated with an increase in pension contributions, and hence that a within-country pattern consistent with the cross-country evidence exists.

In order to evaluate the extent to which the correlation between pension wealth and debt can be interpreted as a causal relationship, we select a subset of the Danish population for further analysis. Crucially, individuals in our estimation sample are chosen to ensure that they are subject to collective bargaining agreements that impose mandatory contribution rates for occupational pension accounts. Specifically, the sample consists of below-median wage earners working in occupations within cooking, waiting and cleaning services. These are occupations for which collective agreements dictate the pension contribution rates. Moreover, all wage earners in the sample have a minimum of 5 years of employment in both public and private sectors. Figure 2 presents contribution rates for these two sectors from 1995 to 2015, showing that, today, private and public sector employees in the selected occupations have almost identical rates, but the current level was introduced much earlier in time for employees subject to the public sector agreements compared to their private sector peers.

1.1 Data and sample selection

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

[5]For further details regarding the collective labor market agreements, see Appendix A.

[6]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 favorable tax treatment.

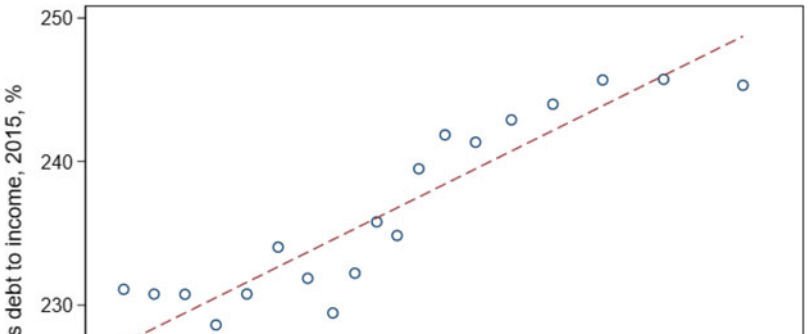

Figure 1. Change in pension contribution rates and debt accumulation.
Notes: Binned scatterplot of the debt to income–ratio as a function of the average annual change in the pension contribution rate in the period 1995–2008. Income has been calculated as an average over 2010–2015. Debt to income has been winsorized at the 95th percentile. The figure is based on all individuals in Denmark aged 30–59 years in 2015 for which employment information in the period 1995–2008 is available (n = 1,039,366). Each dot represents 5% of all observations in the group.
Source: Own calculations based on register data from Statistics Denmark.

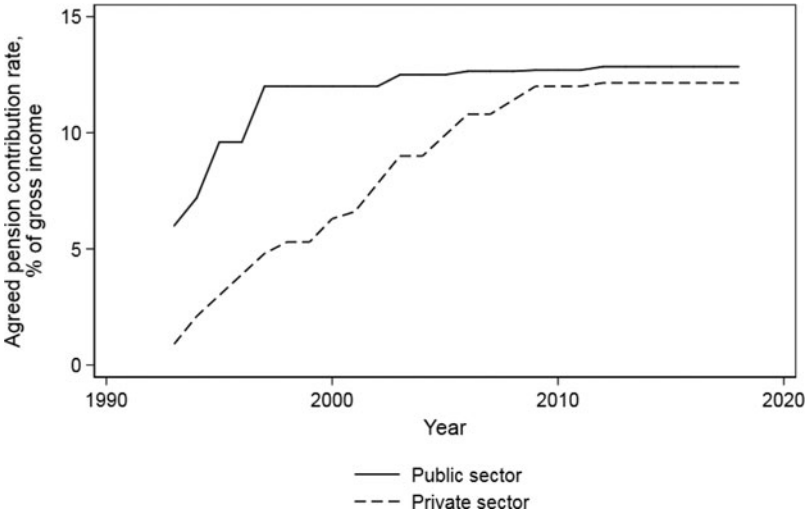

Figure 2. Pension contribution rates according to collective labor market agreements between unions and employer associations.
Notes: Agreed pension contribution rates between the Danish Trade Union Confederation and the Ministry of Finance (public sector) and the Confederation of Danish Employers (private 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.

Occupations (ISCO). These data are combined with detailed balance sheet data containing information on mortgage debt, non-mortgage debt, as well as pension savings, savings in banks, stocks and bonds. 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 of one of the largest pension funds – and the largest occupational pension fund – in Denmark, PensionDanmark. Their members cover mainly blue collar workers within e.g., transportation, hotel and restaurants, cleaning and construction as well as workers in local public administrations at the municipal and regional levels. 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 assess which occupation types are well represented in both the public and private sectors; a central piece of information for selecting an appropriate sample to analyze. Furthermore, all members in this pension fund are subject to the collective labor market agreements, implying that their pension contribution rates follow the agreed rates depicted in Figure 2.

Based on the occupation-sector link provided by the pension fund classification information, as well as dialog with their experts, we identify the estimation sample from the administrative registers. The fact that we sample wage earners subject to the collective agreements implies that the pension contributions we observe in the administrative registers cannot be influenced by individual negotiation.[7] The sample contains both privately and publicly employed workers, a key necessity as we want to exploit the difference in contribution rates across times for the two sectors.

Job descriptions from the two sources, Statistics Denmark and the private pension fund, are used to sample wage earners from the administrative registers. 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 with the aim of constructing a dataset of savers where the pension fund's job descriptions are linked as closely as possible to the ISCO code job descriptions.[8] By overlaying contribution rates computed from the microdata on the rates according to the collective agreements, we find an almost identical pattern, where rates increased much earlier for public sector employees compared to their private sector peers. The rates are illustrated in Appendix Figure 8.

Additional selection criteria are, first, that we restrict individuals to have had at least 5 years of employment in the selected job categories such that changes in mandatory rates will actually affect their balance sheets. Second, observations in years in which individuals are registered as self-employed are dropped because we cannot separate their personal income from business income. Third, we focus on individuals aged 18–59 since that allows us to consider savings behavior in the wealth accumulation part of the lifecycle, and finally, we exclude individuals that are in the top or bottom 1% of all outcome variables to reduce noise from extreme observations.[9] Our sample contains 9,591 individuals with non-zero pension wealth in 2015. For the event study we use the first sector switch reported by each worker during 1995–2008.

Descriptive statistics for these individuals are reported in Table 1 along with means and medians for the full Danish population and lower-income households in Denmark. The sample contains 89% women with an average age of 47 years by 2015. Six in ten are married and five in ten are renting their home. The average labor market tenure is 21 years. In total, 40% of those who have had a mortgage had an interest-only mortgage at some point during 2009–15 and 56% had an adjustable rate mortgage at one point during that same period. The mean income before taxes is DKK 299,000. Average

[7]The collective agreements may allow for limited negotiation at the individual level, but in such cases, wage earners can only raise contributions more than the collectively agreed rates. It is not possible to reduce the rates to levels below the collective agreements.

[8]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 5 years between 1995 and 2008: Cooking etc. (512200), Waiter (512300), and Cleaning (913000, 913200, 913210, 913220, 913230, 913245, 913260, 913270, 913300).

[9]The observations dropped are almost equally represented by the two sectors as 48% are private sector employees. We reproduce the analysis while winsorizing extreme observations instead, showing no important changes in our findings.

Table 1. Descriptive statistics

	Estimation sample						Full population		Population, low income	
	Mean	SD	1st quartile	Median	3rd quartile	*N*	Mean	Median	Mean	Median
Pension assets	407,452	189,601	272,351	375,631	514,185	9,591	509,348	362,991	296,881	210,035
Other financial assets	73,899	120,602	12,449	26,644	76,896	9,591	137,089	33,983	80,691	18,362
Housing	377,874	463,397	0	0	695,000	9,591	776,168	470,000	494,775	0
Other debt	137,213	181,188	951	77,015	198,755	9,584	169,415	80,077	144,196	59,222
Mortgage debt	304,219	389,515	0	0	572,753	9,591	430,961	35,159	249,853	0
Income	299,432	85,817	251,403	295,438	342,730	9,591	401,874	353,548	232,795	253,857
Labor market experience (years)	20.53	3.09	19.00	22.00	23.00	9,591	16.74	20.00	13.69	15.00
Age (years)	47.39	7.28	41.00	48.00	54.00	9,591	44.90	45.00	44.53	45.00
Female	0.89	0.31	1.00	1.00	1.00	9,591	0.50	0.00	0.56	1.00
Married	0.60	0.49	0.00	1.00	1.00	9,591	0.56	1.00	0.49	0.00
Renter	0.51	0.50	0.00	1.00	1.00	9,591	0.44	0.00	0.60	1.00
Has (had) IO loan	0.40	0.49	0.00	0.00	1.00	5,309	0.46	0.00	0.45	0.00
Has (had) variable rate loan	0.56	0.50	0.00	1.00	1.00	5,309	0.61	1.00	0.58	1.00

Notes: Monetary variables are measured in 2015 and all wealth information is reported after taxes at the individual level. The figures for the full population and the low-income population are based on all individuals in the Danish population aged 30–59 years. The low-income population is defined as all individuals aged 30–59 years with an income below the median income of this age group in 2015.
Source: Own calculations based on register data from Statistics Denmark.

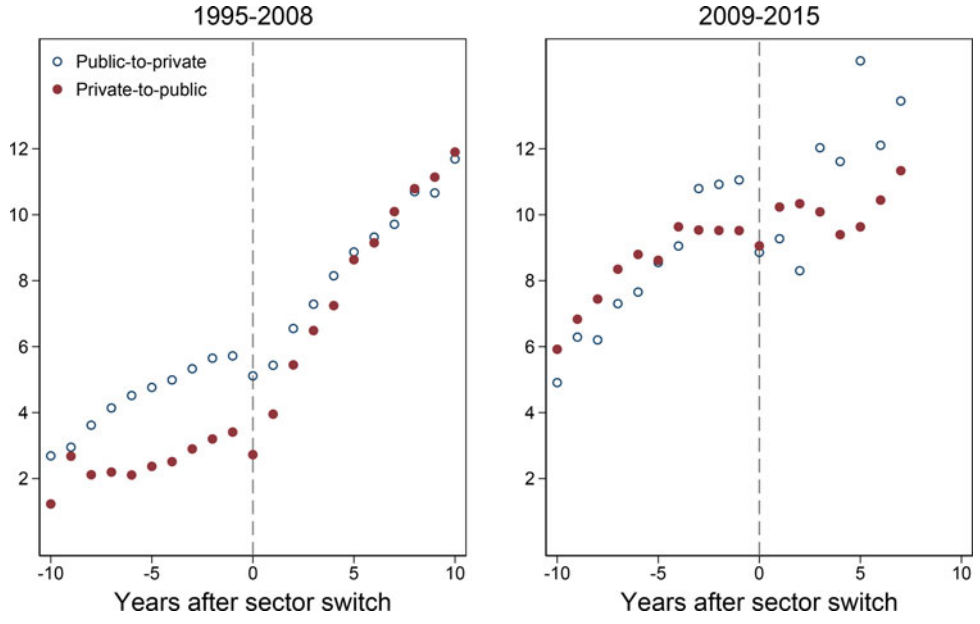

Figure 3. Contribution rate for employer-provided pension accounts (%).
Notes: The dots represent the mean pension contribution rate in each time period, where 0 is the time of switching sector when taking up a new job. Positive values indicate the time after the sector switch and negative values counts the years before switching. The left panel contains sector switches that took place in 1995–2008 and the right panel contains switches in 2009–15. The red dots are wage earners who switch from private to public sector job within the same occupation type and the blue, hollow dots are switches from public sector to the private sector, also within the same job categories. A formal test of parallel pre-trends is illustrated in Appendix Figure 9.
Source: Own calculations based on register data from Statistics Denmark.

mortgage debt and housing wealth are DKK 304,000 and 378,000, respectively, implying a loan-to-value of around 80%. Assets in stocks, bonds and bank deposits are DKK 74,000 in total, while non-mortgage debt is DKK 137,000. The latter covers both collateralized loans, e.g., financing for housing that exceeds the loan to value threshold of 80%, revolving credits in banks, and other debt such as auto loans. Finally, the average pension wealth is DKK 407,000, corresponding to about USD 60,000. Individuals in the estimation sample are remarkably similar to the low-income part of the Danish population in terms of income, asset and debt distributions, where low income is defined as below-median income in 2015.

2. Event study: behavior after sector switch

All employees in our sample have switched from private to public sector, or vice versa, within the same occupation types during 1995–2015. We exploit this in an event study design to examine how each balance sheet component changes for up to 10 years after the sector switch. We group the individuals based on the direction of the first sector switch recorded in the sample period, such that one group holds individuals who switch from private-to-public sector employment and the other group consists of individuals who switch from public-to-private sector jobs.

Based on the administrative data, Figure 3 shows mean contribution rates for occupational pension accounts split by the direction of the sector switch. The horizontal axis counts the number of years relative to the sector switch, such that 0 represents the year of the switch, 1, 2 and 3 indicate 1, 2 and 3 years after switching sector, while the negative values count the years before the switch in a similar fashion. The solid dots present the mean rates for individuals who shifted from a private sector job to a public sector job with similar job content. The hollow dots represent individuals who switch from public to private sector. The left panel shows the early time period, 1995–2008, where discrepancies between public and private sector rates were larger and the right panel shows the later calendar years, 2009–15, in which contribution rates were almost identical for the two sectors, according to the agreed rates in Figure 2. The evidence indicates that shifting into the public sector in the early part of the sample period is clearly associated with an increased contribution rate, while this pattern is not evident in the later years of the sample. We proceed with this event-type design focusing solely on 1995–2008 to examine how balance sheets of these wage earners changed when they switched sector.

Figures 4a–4d show the mean value of each balance sheet component, measured by end of the year in DKK 1,000, across the time of a sector switch. The illustrations are based on individuals from the estimation sample for whom we have sector switches recorded during 1995–2008. Also, we restrict savers to be included if they appear in the data both before and after the sector switch.

Figure 4a illustrates how pension wealth develops by plotting the accumulated pension contributions for each individual in the sample as proxy for wealth. Note that the measure of pension wealth used here is constructed by summarizing contributions from year-to-year and adding a fixed annual return of 5%. We do this because we lack the pension wealth information in the panel dimension. Accumulating the flow of pension contributions over time is the best possible proxy for pension wealth in the panel dimension. In the next section, we turn to detailed wealth information in the cross-sectional data sources. After the time of switching sectors, the slope is steeper when switching to a new job in the public sector from the private sector than vice versa. The distinct divergence in slopes after the switches indicates that wage earners in public sector occupations accumulate more pension wealth over the years, a pattern fully consistent with the increase in contribution rates shown in the left panel of Figure 3.

Even 10 years after the sector switch, the two groups have almost identical savings stored in financial accounts, see Figure 4b. This implies that the increase in pension assets is not crowded out by reduced savings in liquid savings accounts. Figure 4c, on the other hand, illustrates that debt increased by a similar pace for the two groups before the sector switch, but after switching sectors, employees who ended up in public sector jobs accumulated substantially more debt. The increase in debt

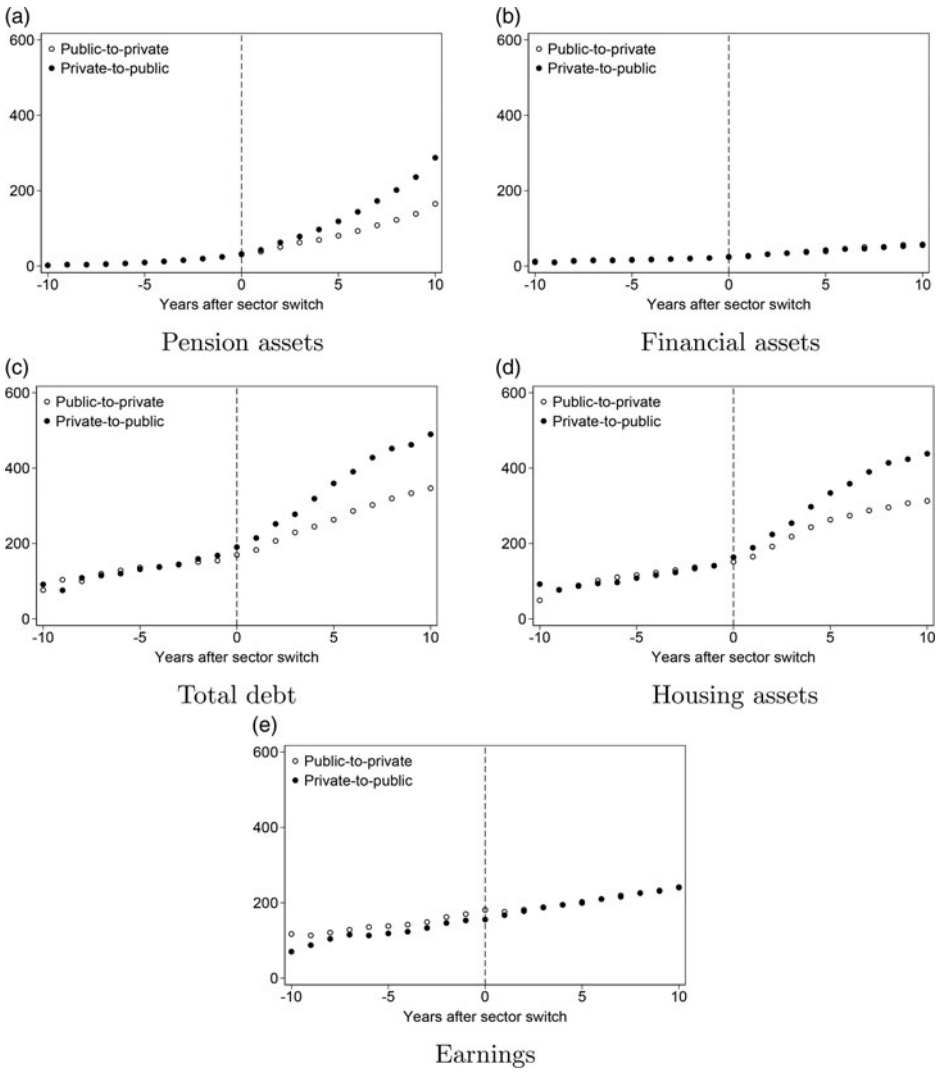

Figure 4. Assets, liabilities and earnings across sector switches (DKK 1,000).
Notes: Panel (a) presents the accumulated contributions for pension accounts. These numbers do not reflect actual pension wealth as compounded net returns and initial pension wealth are not included. Panel (b) shows the sum of bank deposits and the value of stocks and bonds. Panel (c) shows the sum of mortgage debt and non-mortgage debt. Panel (d) shows the value of housing according to Statistics Denmark estimations. Panel (e) shows earnings which is total remuneration excluding pension contributions. To account for minor differences in levels prior to the switches, the public-to-private sector switchers have been parallel shifted to match the private-to-public switchers, based solely on the pre-switch years, on average. Note that this does not change the profiles of the outcome but rather enables better comparison of developments. This parallel adjustment is not used in the regression model in equation (1) which tests for whether the divergence in outcomes across the timing of sector switch is statistically significant. See the notes in Figure 3 for more information. Formal tests of parallel pre-trends are illustrated in Appendix Figure 11.
Source: Own calculations based on register data from Statistics Denmark.

accumulation happened gradually over the years and not by any distinct jump around the job change. In fact, the debt profiles mimic the housing asset development closely. Figure 4d shows that the value of housing assets increased substantially for private-to-public sector switchers relative to employees who performed the opposite type of sector switch.

A number of potential confounders, for example differences between the composition of treatment and control groups, could be important for the interpretation of our results. We start by noting that

the treatment and control groups are remarkably similar in terms of e.g., income, wealth, debt and age composition at the year in which individuals switch sectors.[10] We also investigate whether our results could be driven by geographical differences, for example public sector jobs being located in larger cities where housing prices may be higher. This is not the case.[11] As a further validation test of our approach, we note that changes in pension wealth, and any related changes in other balance sheet components, around a sector switch should only occur in calendar years where contribution rates differ substantially between private and public sector employees. This implies that no significant changes would be expected in years in which contribution rates in the two sectors are identical. To test this graphically, we reproduce the illustrations of wealth and debt developments around a sector switch, using the post-2009 sample period in which rates are almost fully aligned between the two sectors. Reassuringly, Appendix Figures 14a–14c show no distinct changes in either pension wealth, nor financial assets and debt related to a sector switch during this period. This is an indication that the observed movements in balance sheets in our baseline specification are likely to be connected to the change in pension contributions rather than some other unobserved factor.

An important additional potential confounder is differential income developments, which would be positively correlated with both pension assets and debt accumulation over time. However, earnings across the timing of the sector switches, as shown in Figure 4, indicate that public sector employees did not earn more than their private sector peers either prior to or after changing sectors. To test the financial portfolio developments more formally, we specify a difference-in-differences regression model that nests the event study design, in which we can also control for income developments, and other factors, at the individual level:

$$\begin{aligned} y_{i,t} = {} & \alpha + \beta_1 POST + \beta_2 POST \times toPUBLIC_i \\ & + \beta_3 TREND_t + \beta_4 POST \times TREND_t \\ & + \beta_5 toPUBLIC_i \times TREND_t \\ & + \beta_6 POST \times toPUBLIC_i \times TREND_t \\ & + \omega_i + d_t + \gamma X_{i,t-1} + \delta \Delta I + \varepsilon_{i,t}, \end{aligned} \tag{1}$$

where $y_{i,t}$ is the balance sheet component for individual i in t years after the sector switch. A dummy variable, *POST*, equals 1 for all years after the sector switch, otherwise zero, and another dummy variable, *toPUBLIC*, takes the value 1 for workers who switch from private-to-public sector, and zero for switches in the opposite direction. $TREND_t$ is the linear time trend. Individual fixed effects imply that we estimate the within-worker effects; calendar year and age dummies enable us to interpret the estimates as being orthogonal to macroeconomic developments and life-cycle effects. Moreover, dummies for each municipality are included to capture geographical variation, e.g., local labor market and housing market characteristics, that may affect saving and debt outcomes, as well as house price developments. The vector, $X_{i,t-1}$. contains a range of observable information from the administrative registers, including, marital status and the end-of-year values of housing assets, financial assets, mortgage debt, non-mortgage debt, unemployment insurance transfers and income. ΔI is the change in total compensation, that is the sum of earnings and pension contributions, from year $t-1$ to year t in order to compare savings behavior between workers despite the difference in total remuneration that they may experience over the years. Finally, $\varepsilon_{i,t}$ is the error term.

The parameter of interest is β_6, that provides an estimate of the difference in the slopes between the two groups in the post-switch time period. Table 2 presents the estimated parameters for each of the balance sheet components. The results imply that pension assets accumulation increases, on average, by DKK 3,700 each year after a private-to-public sector switch, relative to switching in the opposite

[10]See Appendix Table 8 for further details.

[11]The median value of housing assets among individuals in the sample, conditional on being a homeowner, is 710,000 DKK for individuals employed in the public sector and 700,000 DKK for individuals in the private sector.

Table 2. Balance sheet components after sector switch (DKK 1,000)

Variables	(1) Pension	(2) Assets	(3) Non-mortgage	(4) Mortgage	(5) Housing	(6) Homeowner
POST	−2.215*	0.535	−1.469	−6.333	−10.910*	−0.019***
	(1.322)	(1.212)	(2.151)	(4.651)	(5.788)	(0.007)
POST × *toPUBLIC*	0.285	−0.601	−0.574	9.200	9.018	0.020*
	(1.915)	(1.755)	(3.116)	(6.737)	(8.384)	(0.010)
TREND	25.106***	2.046*	3.749*	6.628	7.752	0.007
	(1.250)	(1.146)	(2.034)	(4.398)	(5.473)	(0.007)
POST × *TREND*	−2.318***	0.212	−0.242	5.360***	5.678***	0.006***
	(0.321)	(0.294)	(0.522)	(1.129)	(1.405)	(0.002)
toPUBLIC × *TREND*	−5.058***	0.508	0.248	−2.075	−2.873	−0.004*
	(0.422)	(0.386)	(0.686)	(1.483)	(1.846)	(0.002)
POST × *toPUBLIC* × *TREND*	3.664***	−0.530	0.840	3.591**	5.844***	0.005**
	(0.456)	(0.418)	(0.741)	(1.603)	(1.995)	(0.002)
Observations	52,789	52,789	52,789	52,789	52,789	52,789
R^2	0.85	0.13	0.21	0.25	0.27	0.18
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01. Outcome variables: (1) Accumulated pension contributions. To proxy pension wealth we assume a fixed annual net return of 5%, (2) Taxable financial assets, (3) Debt, excluding mortgages, (4) Mortgages, (5) Housing wealth reported by Statistics Denmark which is based on the tax base of each home adjusted by current, local trades, and (6) a dummy for being a homeowner.
Source: Own calculations based on register data from Statistics Denmark.

direction. In a similar fashion, financial assets decline by DKK 500 each year and non-mortgage debt increase by DKK 800. These latter numbers are both very modest in size and not statistically significant at any conventional level. Mortgage debt increases each year by DKK 3,600 more when switching to a public sector job relative to switching to a private sector job. And finally, the value of housing increases by DKK 5,800 more for private-to-public sector switches compared to peers who perform the opposite type of switch. The important takeaway is that the differential increase in pension wealth, proxied by stacked contributions, is not statistically different from the differential increase in debt.

The numbers imply substantial crowding out in retirement savings through debt. The increase in debt is backed by real property as housing assets increase substantially during the same period. The increase in debt relative to the rise in home values is, on average, 3.591/5.844 = 61%. These changes appear not to be driven by changes in income, which leads us to conclude that the interplay between pension wealth and debt accumulation may be operating through the housing market. By plotting the propensity to be a homeowner across the time of switching sectors, we see that homeownership rates increase more for workers who switch from private to public sectors (see Appendix Figure 10 and column (6) in Table 2). This indicates that, by raising pension savings and thus increasing overall savings, workers may find easier access to the housing market.

The interpretation of the underlying mechanisms that drive our main results is not straightforward. Housing wealth may rise because savers, who are forced to increase mandatory pension contributions, become more likely to buy a home (extensive margin response), but also because they are able to buy more expensive properties conditional on buying a home (intensive margin response). These possible responses imply that the observed pattern is driven by an increased supply of credit, where banks are more willing to grant a mortgage loan to households with higher savings rates. On the other hand, the pattern could also be explained by an increased demand for credit. As house prices increase over time, home equity also increases. This allows homeowners with a now-higher pension contribution rate to extract equity in order to regain some liquid wealth. Unfortunately, we are unable to separate demand from supply side effects in our empirical setup and leave the disentanglement of the driving forces to further research.

Taking up a new job may be associated with other changes in individuals' balance sheets. Workers could have extraordinary expenses around the time of switching jobs, which could lead them to increasing their debt level. In order to ensure that such behavior is not driving our results, we perform the event study using a sample of individuals that switch job but remain within the same sector. Such job changes are not accompanied by any significant change in pension contribution rates and we should not expect to see any substantial changes in debt after the switch if our interpretation is correct. Appendix Table 9 presents the coefficients of such a placebo test, showing no significant changes in wealth and debt balances. This implies that the change of sector and associated change in pension contributions is the important driver of our results, not changing jobs *per se*.

Another potential bias could be that the timing of sector switches is correlated with housing demand (Kleven *et al.*, 2019). For example, individuals may be more likely to switch sector when households move because of the spouse finding a new job. Reassuringly, our results are similar if we disregard individuals whose partner get a new job in the same year in which they switch sector (see Appendix Table 10), as well as in a more general robustness check where we control for partners' income, wealth and debt level (see Appendix Table 11).[12]

In order to obtain a more precise estimate of the borrowing response when pension contributions rise, we turn to a more detailed administrative register that holds information on the exact pension wealth in 2015. So far, we have used annual contributions, accumulated over time, to proxy for wealth. An assessment in the cross section of pension savers using the wealth register allows us to estimate movements in the balance sheet more accurately, and also to take into account longer run effects. Taking longer run effects into account is particularly important since our results indicate that the housing market may play a role, and since housing transactions at the individual level are rather infrequent.

3. Cross section: 2SLS regression model

In this section, we develop a very different empirical test that exploits cross-sectional variation in 2015 as well as job market and earnings histories over the previous two decades to quantify the impact of an increase in pension wealth on non-retirement savings accounts and debt. Moreover, we use this setup to learn more about homeownership and borrowing behavior.

The first stage of our 2 stage least squares (2SLS) approach regresses pension wealth in 2015 on a constructed instrument variable. The instrument measures the difference between how much is saved in pension accounts during public sector employment and how much that would have been saved in an identical but private sector job in the same year. This implies that the instrument can be interpreted as the excess public sector pension savings for each individual. To be more specific, this amount, which we will denote *Exposure* or E_i, is calculated as

$$E_i = 0.6 \times \sum_{t=1995}^{2008} D_{it}^{pub} \times (p_{it} - p_t^{pri}) \times w_{it} \times (1+r)^{2015-t} \tag{2}$$

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

[12]Similarly, the occasion of becoming parents could be a potential confounder that could induce sector switches. However, in our sample the unconditional probability of changing sector is similar for individuals that became parents in a given year or the previous year (probability of changing sector: 12.4%), and for individuals that did not become parents (12.8%). Therefore, in our application this does not seem to be a likely confounder.

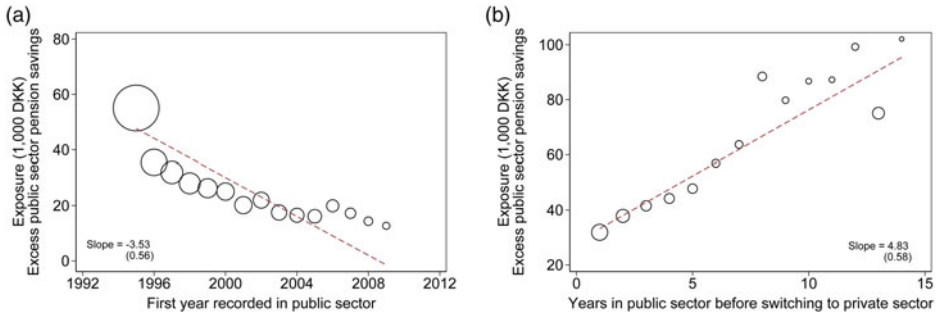

Figure 5. Time-variation in exposure to mandatory pension contribution rates.
Notes: Panel (a) shows the mean value of $Exposure_i$, which captures the excess exposure to wage earners because of their employment in public sector jobs relative to employees in private sector jobs with the same job content. The size of the circles indicates the frequency of savers in each calendar year. Panel (b) shows the mean value of $Exposure_i$ in a similar fashion over the number of years that wage earners were employed in the public sector before switching to new job with similar job content but in the private sector. *Source*: Own calculations based on register data from Statistics Denmark.

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.

The constructed measure of exposure to mandatory pension contributions implies that individuals, who were employed in the public sector earlier rather than later in their career should have a relatively high number recorded. Figure 5a illustrates this pattern exactly, by plotting the mean $Exposure_i$ by the calendar year that individuals were first recorded as public sector employee in the sample. $Exposure_i$ is clearly declining in the first year of public sector employment indicating that the measure captures a time-sector gradient in mandatory rates. Furthermore, we should also see that workers who remain in the public sector for many years before switching to the private sector would have a larger exposure to mandatory pensions. Figure 5b plots the mean *Exposure* within each number of years that employees were connected to a public sector workplace before taking up a job in the private sector. The illustration confirms an increasing gradient of exposure across this dimension.

We assume $Exposure_i$ to be exogenous to total borrowing in 2015, which is the exclusion restriction in our design. This implies that we assume workers to have had similar borrowing behavior across the 20 year period had there not been a wedge in mandatory pension contribution rates between public and private sectors. This requirement to our instrument cannot be tested formally. However, we turn to some graphical evidence in order to check that our identifying assumption is not violated. First we plot developments in the total compensation over time for public and private sector employment. Figure 6 shows that total compensation, that is the sum of earnings and pension contributions in each year, was strikingly similar for the sectors across the calendar years. The fact that public sector employees did not display steeper income growth than their private sector peers mitigates the concerns of income developments as a confounder.

Another possible threat to identification that cannot be controlled for using observables from the administrative registers is individual preferences. Imagine for example workers with a risk-seeking type of behavior, who may start their career in the public sector, e.g., cooking in a governmental administration office cafeteria, but then seek new opportunities mid-career in the private sector restaurant. In this case, the private-sector workplace is more exposed to the business cycles and generally more likely to close than the public-sector workplace. In our measure of exposure to mandatory pension contributions, this type of worker would gain a high rate of exposure. At the same time the worker's risk-seeking behavior predicts a high level of borrowing. The estimated effect of pension wealth on debt would then be confounded by risk preferences. To mitigate these concerns we examine if the

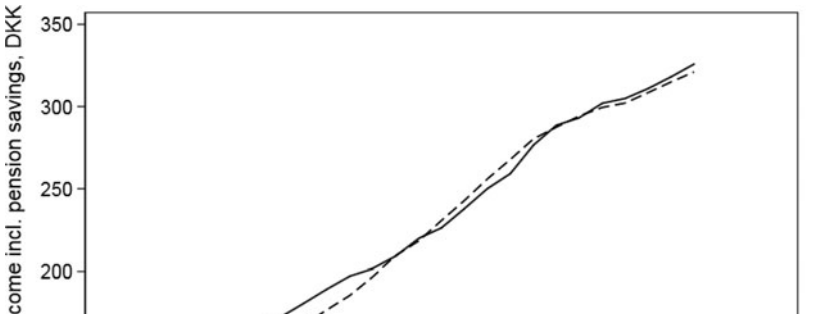

Figure 6. Total compensation (income, incl. pensions).
Notes: The graph is constructed by measuring median income, including pension contributions, in each calendar year for public (blue) and private (purple) sector workers.
Source: Own calculations based on register data from Statistics Denmark.

instrument is correlated with factors that may reflect individual preferences. Appendix Figure 13 illustrates the correlation between the instrument and two measures of preferences, income volatility and the ratio of liquid assets to income, by plotting each of these variables against equal-sized bins of $Exposure_i$. There is no statistically significant sign of correlation between exposure and these two measures. This indicates that workers, who are more exposed to mandatory pension contributions, have not had more or less volatile income streams or different preferences for savings in comparison with less exposed workers.

Figure 7 presents the correlation between $Exposure_i$, the instrument and pension wealth measured in 2015, the endogenous variable. The dots represent the mean within 20 equally sized bins and the line shows the fitted linear regression. The slope of 1.17 indicates that the overall pension wealth in 2015 increases by 117 dollars for each 100 dollar mandatory contributions to occupational pension plans during 1995–2015. This implies that accrued capital gains constitute at least 17%, on average, while crowding out through a decline in voluntary pension contributions must be limited.[13] The plot serves as first-hand evidence that *Exposure* is highly correlated with the endogenous variable[14]:

$$P_i^{2015} = \alpha + \delta E_i + \beta X_i + \varepsilon_i \tag{3}$$

Equation (3) 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. The vector holds indicators for years of employment in the private sector and similarly, a counter for number of years employed in the public sector. This

[13]The fact that the slope is larger than one could also reflect that workers increase contributions for voluntary pension accounts when experiencing an increase in the mandatory contribution rates in their occupational pension accounts. 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.

[14]The mean of $Exposure_i$ 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. The distribution of $Exposure_i$ is shown in Appendix Figure 12.

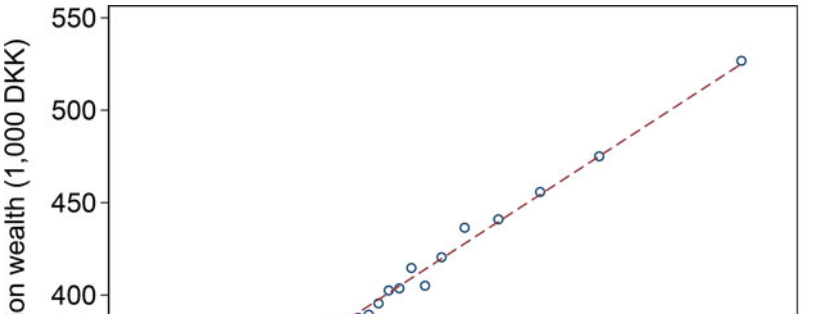

Figure 7. Correlation between exposure and pension wealth in 2015.
Notes: The exposure measure is constructed by stacking individual contributions for occupational pension accounts in years with public sector employment minus median contributions in private sector for similar jobs in that same year, as per equation (2).
Source: Own calculations based on register data from Statistics Denmark.

ensures that we compare individuals with equal tenure in both sectors. Moreover, we control for gender, age fixed effects, total labor market tenure fixed effects, a counter for the number of sector switches registered and municipality fixed effects. Together, these covariates control flexibly for life-cycle effects and local labor market effects. In order to compare individuals across the wealth distribution, we control for the liquid wealth quartile measured in the first year that they appear in the data. By doing so, we avoid introducing bad controls, e.g., control variables that are outcomes themselves, in the specification. Similar quartiles are included for housing wealth and debt. Finally, income is usually correlated with both pension wealth and debt accumulation at the individual level. Our sample selection mitigates the concern, however, that income is the factor that explains the balance sheet developments in our data. This is illustrated in both Figures 4 and 6. Nonetheless, we include income both by the year of measurement, 2015, and the sum of income across the full sample period for each saver. Ultimately, this means that we compare savers who have had the same cumulative income across the sample period and have an identical income level in the year in which we observe the financial portfolio.

The abovementioned specification serves as our preferred model. However, limiting the set of explanatory variables comes with the risk of omitted variable bias. We have therefore estimated additional specifications to test the sensitivity of our baseline results. Additions to the model are, first, indicators for whether each individual either purchased or sold property for each given year that they appeared in the data. Moreover, we interact the municipality dummies with an indicator that takes the value 1 if the individual during the sample period moved out of the municipality where they were initially living. These additions should capture potential historic house price dynamics playing a role for housing wealth in 2015. The second type of addition to the baseline model is to include more information about income dynamics. Here, we include measurements in each year for each saver, showing the amount of unemployment benefits received, salary, capital gains and finally, the change in income across the years of the first sector switch reported. Both alternative specifications can be found in Appendix C and they show that our results do not change in any important way.

In addition, it may be argued that decisions related to debt accumulation are made at the household level, rather than the individual level. Our empirical setup is best targeted an analysis at the individual level, mainly for two reasons. First, changes in household compositions are substantial over 20 years. If we, for example, were to consider only households that exist over the full sample period and control for

income trajectories, etc., we would end up with a very small and selected sample. And second, when it comes to married couples, and also in many other cases, it is common to split homeownership and the associated debt in two, such that each adult household member owns each their share, typically 50%. Our main approach will therefore in most cases capture also those decisions that are made at the household level. We have checked that our main results hold when using pension wealth and debt at the household level as outcomes (see the discussion on robustness tests later).

In the second stage, the variable of interest, total debt in 2015, D_i^{2015}, is regressed on total pension wealth, where the latter is instrumented by the exposure measure:

$$D_i^{2015} = \alpha + \gamma \widehat{P_i^{2015}} + \beta X_i + r_i \tag{4}$$

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 dependent variables. The parameter of interest is γ, 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 50, and E_i is thus relevant in the sense of Stock and Yogo (2005).

4. Results

The impact of an increase in pension wealth on non-retirement savings and debt is presented in Table 3. Column (1) shows the first-stage equation in the 2SLS model where the endogenous variable is regressed on the instrument. The coefficient implies that total pension wealth in 2015 increases by 17 cents for each 1 dollar increase in $Exposure_i$. Columns (2)–(7) present the second-stage equations where debt and non-retirement wealth in 2015 are estimated as a function of pension wealth, measured in the same year, where the latter is instrumented by $Exposure_i$.

Column (2) in Table 3 shows that total debt increased by 42 cents, on average, for each 1 extra dollar of pension wealth. Columns (3) and (4) in Table 3 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% loan to value 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 42 cents, while there is no effect on non-mortgage debt.

Columns (5) and (6) of Table 3 present the change in liquid assets and housing wealth, respectively, for each 1 extra dollar of pension wealth. The former does not change to any statistically significant degree, while the latter rises by 51 cents. We return to this issue in the next section.

Finally, column (7) of Table 3 shows that net wealth, excluding pension assets, does not change significantly for an increase in pension wealth. This measure of net wealth includes savings in non-retirement accounts and real assets. Together, the results indicate that employer-provided pensions are not crowded out by less savings outside the pension system, nor does the increase in borrowing cancel the rise in retirement savings. In fact, it seems that the increase in pension wealth is linked to an additional increase in housing assets, accompanied by an increase in mortgage debt. This underpins the importance of taking a long-term view on household finances, since decisions to buy or sell real estate are relatively infrequent and because housing wealth plays a significant role for the individual savings pattern.[15] Overall, mandatory pension savings raise overall savings, but also entail a substantial increase in gross debt at the individual level.

[15]For the same reasons, savings behavior may not be explained by active choices, where savers frequently reoptimize their budget in order to smooth consumption. Rather, people may adapt to a new savings rate once they buy property. This implies that the increase in mandatory pension contribution rates does not affect borrowing behavior immediately, but does so with substantial delay. Such explanation would be consistent with a large degree of passive savings behavior, as previously found by Chetty *et al.* (2014).

Table 3. IV-regression results: effect of pension wealth on assets and liabilities

Variables	(1) Pension	(2) Debt	(3) Mortgage	(4) Non-mortgage	(5) Assets	(6) Housing	(7) Net wealth
$Exposure_i$	1.168***						
	(0.031)						
Pension		0.416***	0.422***	−0.006	0.044	0.510***	0.139
		(0.108)	(0.103)	(0.047)	(0.028)	(0.096)	(0.102)
Observations	9,591	9,591	9,591	9,591	9,591	9,591	9,591
R^2	0.672	0.131	0.125	0.075	0.129	0.184	0.144
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic		97	97	97	97	97	97

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.
All figures are reported after taxes in 2015. Net wealth is the sum of all wealth components excluding pension wealth, minus total debt. Control variables: Indicators for years of employment in the private sector and in the public sector, gender, age fixed effects, total labor market tenure fixed effects, a counter for the number of sector switches registered, municipality fixed effects, quartiles of liquid wealth, housing wealth and debt measured in the first year individuals appear in the data, as well as income in the year of measurement, 2015, and the sum of income across the full sample period for each individual.
Source: Own calculations based on register data from Statistics Denmark.

4.1 Potential mechanisms

Standard lifecycle models predict that savers should dissave in non-retirement accounts or borrow when being forced to increase contributions to retirement plans. Although we cannot rule out such behavior in our setup, the fact that we find an increase in housing assets implies that consumption smoothing is not the only explanation for the co-movement in pension wealth and debt.

Savings in pension accounts cannot directly serve as collateral for credit in banks and mortgage banks. However, pension wealth raises replacement rates, allowing borrowers to service debt well into their retirement. Savers may for this reason be more willing to enter the housing market. Rebalancing of risks may also play a role along with an increasing share of household wealth being stored in illiquid pension accounts. In addition, banks and mortgage banks may be more willing to lend to individuals who save in pension accounts compared to identical individuals without pension wealth. Unfortunately, the empirical setup in this paper does not allow us to separate such demand and supply effects, a topic we therefore leave for future research.

To test whether increased pension wealth leads to increased homeownership rates we use the empirical model explained in equations (3) and (4). Table 4 shows the second stage of the 2SLS regression using a dummy for homeownership as dependent variable in column (1). The endogenous variable, pension wealth is measured in DKK 1,000, and instrumented by $Exposure_i$. The parameter indicates that a DKK 1,000 increase in pension wealth from one year to the next increases the propensity to be homeowner by 0.05 percentage points. This seems like a very small effect, but when regressing the same dependent variable on the log of pension wealth, we find that homeownership rates increase by 0.2 percentage points for each 1% increase in pension wealth (column 4). When individuals in our sample appeared the first time in our dataset 27% of them where homeowners. This implies that increasing pension wealth by 1% leads to an increase in the probability of owning a home by 0.002/0.27 = 0.7%.

An additional way to boost debt accumulation through the mortgage market is to defer amortization by using interest-only mortgages. In columns (2) and (5), the dependent variable is a dummy for having had an interest-only mortgage at some point during the sample period. The results show that for each 1% increase in pension wealth, the propensity to defer amortization increases by 0.2 percentage points. This is, of course, conditional on owning a home and the baseline probability for having an interest-only mortgage is 53%. This implies that a 1% increase in pension wealth causes an increase in the interest-only probability of 0.4%. Hence, part of the relation between pension wealth and debt accumulation can be explained by increased homeownership rates and higher propensities to use interest-only mortgages as pension wealth increases. The increased use of interest-only loans along with pension wealth accumulation could be related to intertemporal optimization. However, it

Table 4. Second stage: homeownership rate and mortgage typology

Variables	(1) Homeowner	(2) IO	(3) ARM	(4) Homeowner	(5) IO	(6) ARM
Pension (DKK 1,000)	0.0005***	0.0004**	0.0000			
	(0.0001)	(0.0002)	(0.0002)			
log(Pension)				0.222***	0.192**	0.021
				(0.039)	(0.093)	(0.080)
Observations	9,591	6,275	6,275	9,591	6,275	6,275
R^2	0.1978	0.0517	0.0501	0.199	0.048	0.050
Controls	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	56	69	69	116	79	79

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.
Dependent variables are dummies for being a homeowner (1) and (4), having had an interest-only mortgage at one point during 2009–15 (2) and (5), and similarly, having had adjustable rate mortgages at one point in time during 2009–15 (3) and (6). Parameter values are estimated in a linear probability model.
Source: Own calculations based on register data from Statistics Denmark.

could also be related to individuals facing liquidity constraints to a larger extent when a larger part of their income is saved. While we cannot definitively conclude on the relative importance of each of these two explanations, we note that the main estimate of the impact of pension wealth on debt accumulation does not differ substantially across groups of individuals with varying probabilities of being liquidity constrained, so liquidity constraints do not seem to be the main explanation.[16]

We find no significant change in the propensity to use adjustable rate mortgages over fixed rate, either statistically or economically (columns 3 and 6). This may imply that the appetite for more risky loans, where interest payments could change at a 1, 3 or 5 year horizon relative to a 30-year fixed rate payment, is not preferred to any higher degree when accumulating more pension wealth.

4.2 Robustness

This section presents a range of robustness tests. All tests depart from the main specification of our empirical model in equations (3) and (4), 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 debt response using the main specification but with another definition of exposure, E_i. In the baseline model, we calculate exposure to mandatory pension savings, as explained in equation (2), 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 8. 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) and (3) in Table 5 use different input of the discount rate r into the calculation of E_i. We have obtained an estimated return for each year t from PensionDanmark. When using this estimated figure in the discounting, the debt response does not change significantly from the main specification (column 2). The similar pattern prevails when using 2% and 8% as discount rates in columns (3) and (4), respectively.

Column (5) 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 (5) confirms this exactly.

To test whether debt accumulation determined at the level of the household is consistent with the estimated debt accumulation response at the level of the individual, in column (6) in Table 5 we turn

[16]Appendix Table 13 provides further details in the form of the results from estimation of our baseline specification in subsamples defined by liquidity.

Table 5. Main results: IV robustness

Variables	(1) Agreed	(2) Estimated	(3) 2%	(4) 8%	(5) Renters	(6) Household	(7) Wage register
Pension	0.415***	0.334***	0.526***	0.315***	0.039	0.571***	0.555***
	(0.105)	(0.103)	(0.114)	(0.103)	(0.090)	(0.180)	(0.156)
Observations	9,585	9,579	9,547	9,559	3,361	9,469	6,817
R^2	0.131	0.136	0.118	0.132	0.140	0.241	0.130
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	97	97	98	101	36	20	65

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01. The table presents estimates of the two-stage least-squares model described in equations (3) and (4).
Source: Own calculations based on register data from Statistics Denmark.

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 (4). This seems to be the case as the estimated parameter does not diverge significantly from that of the main specification.

Finally, we enrich our employment information by an alternative administrative register, the wage statistics register compiled by Statistics Denmark. This register could provide a better measure of the sector in which individuals work, but is more limited in its coverage.[17] In the robustness test we exclude individuals from the sample if the information on sector differs in the two datasets. However, the debt response estimated here does not differ in any important way from that in our baseline estimates.

In addition to the robustness tests reported in Table 5, as previously mentioned we also test the sensitivity of our results to alternative sets of control variables, see Appendix C, and to winsorizing outcomes at the top and bottom 1% instead of excluding extreme observations, see Appendix Table 12. Our main findings do not change significantly as a result of any of these changes.

5. Conclusion

In this paper we use 20 years of individual level administrative data containing detailed information about savings and debt for low-wage earners to evaluate the effect of mandatory pension contributions on non-retirement savings and debt. We construct two very different empirical research designs, which both offer insights into the causal link between pension wealth and debt. One design exploits the panel structure of our data in an event study and the other design is a cross-sectional 2SLS regression model that exploits variation in how much each worker has been exposed to mandatory pension contribution rates during their career. Both methods return strikingly similar conclusions; pension wealth is an important driver in explaining household debt accumulation in the long run.

The results show a significant increase in debt of 42 cents, on average, for each dollar increase in pension wealth. This response is closely linked to the housing market. At the extensive margin, we find an increased homeownership rate of 0.7% for 1% increase in pension wealth. Altogether, housing assets increase by 51 cents for each 1 dollar increase in pension wealth. Our findings do not go against the idea that many savers exhibit passive savings behavior, as previously found by Chetty *et al.* (2014). It seems, however, that adjustments to the individual financial portfolio happen with substantial delay which underpins the importance of taking a long-term view on household finances, particularly as

[17]In our baseline data, we infer information on sectors from data in the IDAN register from Statistics Denmark. In the robustness check in column (7), we exclude all individuals for which our sector measure does not correspond to the sector from the wage statistics dataset, LON, also from Statistics Denmark. The latter register provides sector links at the individual level, but for a shorter data period and for a smaller sample of individuals (due to minimum requirements in terms of, inter alia, firm size and hours per month). The differences in coverage could be particularly important in our application, given that private sector employment within the types of occupations considered often takes place in smaller firms. We therefore prefer to use IDAN in our baseline results.

decisions to buy or sell real estate are relatively infrequent. Overall, we conclude that the introduction of mandatory pension contributions significantly raises overall net wealth, as well as gross debt.

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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Appendix A: Details on collective labor market agreements in Denmark

Pension contributions constitute a substantial share of total compensation for employees in occupations covered by collective labor 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 favor 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 labor market model is, however, based on a long history of collaboration between the labor 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. Increasing pension contributions have not reduced disposable income in any of the agreements. 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 are not related 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).

Appendix B: Details on the Danish mortgage credit system

The Danish mortgage system is not very different from systems in many other countries, including the USA, as it provides long-term financing for housing through adjustable and fixed-rate loans.[18] 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 homeowners 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 specialized 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 banks, mortgage banks must meet e.g., capital requirements as well as organizational 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 loan to value limit of 80% 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 amortization. Interest-only mortgages gained rapid popularity since the introduction in 2003 and constituted more than half of the outstanding mortgage value in 2013. Amortization 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 amortization. This enables Danish homeowners to reduce or delay mortgage repayments for a longer period of time. In

[18]Additional details regarding the Danish mortgage system can be found in Andersen *et al.* (2020) and Kuchler (2015).

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 economize 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 is 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.

Appendix C: Alternative IV-regression specifications

Control variables in the baseline specification reported in Table 3 are indicators for years of employment in the private sector and in the public sector, gender, age fixed effects, total labor market tenure fixed effects, a counter for the number of sector switches registered, municipality fixed effects, quartiles of liquid wealth, housing wealth and debt measured in the first year individuals appear in the data, as well as income in the year of measurement, 2015, and the sum of income across the full sample period for each individual.

We have chosen this specification as our preferred one in order to avoid the risk of including bad controls, e.g., control variables that are outcomes themselves. However, limiting the set of explanatory variables comes with the risk of omitted variable bias. We therefore test the sensitivity of our results to including additional control variables. In Table 6, we add indicators for whether each individual either purchased or sold property for each given year that they appeared in the data. Moreover, we interact the municipality dummies with an indicator that takes the value 1 if the individual during the sample period moved out of the municipality that they were initially living in. These additions should capture possible dynamics where homeowners earn profits on the market for housing. In Table 7, we also include more information about income dynamics. Here, we include measurements in each year for each saver, showing the amount of unemployment benefits received, salary, capital gains and finally, the change in income across the years of the first sector switch reported. Both alternative specifications imply that our results do not change in any important way.

Table 6. IV-regression results: effect of pension wealth on assets and liabilities – alternative specification 1

Variables	(1) Pension	(2) Debt	(3) Mortgage	(4) Non-mortgage	(5) Assets	(6) Housing	(7) Net wealth
$Exposure_i$	1.171***						
	(0.032)						
Pension		0.384***	0.404***	-0.020	0.044	0.478***	0.137
		(0.102)	(0.099)	(0.047)	(0.028)	(0.096)	(0.100)
Observations	9,591	9,591	9,591	9,591	9,591	9,591	9,591
R^2	0.676	0.162	0.157	0.090	0.134	0.225	0.161
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic		66	66	66	66	66	66

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.
All figures are reported after taxes in 2015. Control variables in addition to those from main specification: Indicators for whether each individual either purchased or sold property for each given year that they appeared in the data, and interactions of municipality dummies with an indicator that takes the value 1 if the individual during the sample period moved out of the municipality that they were initially living in.
Source: Own calculations based on register data from Statistics Denmark.

Table 7. IV-regression results: effect of pension wealth on assets and liabilities – alternative specification 2

Variables	(1) Pension	(2) Debt	(3) Mortgage	(4) Non-mortgage	(5) Assets	(6) Housing	(7) Net wealth
$Exposure_i$	1.136***						
	(0.032)						
Pension		0.362***	0.406***	-0.045	0.043	0.472***	0.154
		(0.094)	(0.101)	(0.053)	(0.028)	(0.092)	(0.100)
Observations	9,591	9,591	9,591	9,591	9,591	9,591	9,591
R^2	0.696	0.177	0.173	0.102	0.215	0.244	0.197
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic		56	56	56	56	56	56

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.
All figures are reported after taxes in 2015. Control variables in addition to those from main specification: Controls from Table 6 plus measures in each year for each saver, showing the amount of unemployment benefits received, salary, capital gains, and the change in income across the years of the first sector switch reported.
Source: Own calculations based on register data from Statistics Denmark.

Appendix D: Supplementary figures and tables

Table 8. Descriptive statistics by direction of first sector switch

	Private to public			Public to private		
Direction of switch	Mean	Median	*N*	Mean	Median	*N*
Income	203,091	204,954	2,029	198,715	202,369	1,945
Housing wealth	213,663	0	2,029	201,915	0	1,945
Ratio of debt to housing wealth	107	99	812	106	101	695
Financial Assets (excl. pension savings)	26,869	11,523	2,007	28,211	10,777	1,923
Mortgage debt	155,725	0	2,010	148,488	0	1,926
Other debt	74,807	45,087	2,011	72,041	38,050	1,929
Age (years)	34.70	35.00	2,029	33.29	33.00	1,945
Female	0.93	1.00	2,029	0.84	1.00	1,945
Married	0.49	0.00	2,029	0.39	0.00	1,945
Renter	0.60	1.00	2,029	0.64	1.00	1,945
Has (had) IO loan	0.55	1.00	1,420	0.58	1.00	1,352
Has (had) variable rate loan	0.66	1.00	1,420	0.69	1.00	1,352

Notes: Income is measured in the year before the sector switch.
Source: Own calculations based on register data from Statistics Denmark.

Table 9. Balance sheet components after within-sector job switch (DKK 1,000)

Variables	(1) Pension	(2) Assets	(3) Non-mortgage	(4) Mortgage	(5) Housing	(6) Homeowner
POST	0.583	−0.578	4.261	0.854	7.656	0.002
	(2.164)	(2.312)	(3.361)	(7.681)	(10.642)	(0.012)
POST × *toPUBLIC*	−0.720	1.453	−5.223	3.724	−0.706	0.028
	(3.485)	(3.724)	(5.413)	(12.371)	(17.142)	(0.019)
TREND	31.491***	3.599**	1.207	20.293***	12.354	0.013
	(1.614)	(1.725)	(2.507)	(5.729)	(7.938)	(0.009)
POST × *TREND*	−4.741***	−0.786	2.374**	−2.179	1.179	0.000
	(0.609)	(0.651)	(0.947)	(2.163)	(2.997)	(0.003)
toPUBLIC × *TREND*	−2.937***	−1.215	2.786*	2.371	3.816	−0.007
	(0.928)	(0.991)	(1.441)	(3.293)	(4.563)	(0.005)
POST × *toPUBLIC* × *TREND*	−1.736*	1.215	−2.368	0.720	−0.981	0.008
	(0.975)	(1.042)	(1.515)	(3.462)	(4.797)	(0.005)
Observations	13,801	13,801	13,801	13,801	13,801	13,801
R^2	0.90	0.19	0.20	0.29	0.33	0.22
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. See Figure 2 for more information.
Source: Own calculations based on register data from Statistics Denmark.

Table 10. Balance sheet components – individuals whose partner change job excluded (DKK 1,000)

Variables	(1) P	(2) A	(3) B	(4) M	(5) Housing	(6) Owner
POST	−2.192	0.405	−1.571	−4.733	−10.577*	−0.016**
	(1.426)	(1.312)	(2.322)	(5.025)	(6.256)	(0.008)
POST × *toPUBLIC*	0.341	−0.449	−0.339	2.168	1.090	0.006
	(2.064)	(1.900)	(3.362)	(7.276)	(9.058)	(0.011)
TREND	24.975***	1.989*	3.090	4.839	6.121	0.004
	(1.288)	(1.185)	(2.097)	(4.539)	(5.650)	(0.007)
POST × *TREND*	−2.228***	0.306	0.199	6.753***	7.513***	0.010***
	(0.348)	(0.320)	(0.567)	(1.227)	(1.528)	(0.002)
toPUBLIC × *TREND*	−5.052***	0.585	0.479	−2.711*	−3.301*	−0.005**
	(0.455)	(0.419)	(0.741)	(1.604)	(1.997)	(0.002)
POST × *toPUBLIC* × *TREND*	3.592***	−0.799*	0.892	5.262***	7.127***	0.007***
	(0.492)	(0.452)	(0.800)	(1.732)	(2.157)	(0.003)
Observations	45,091	45,091	45,091	45,091	45,091	45,091
R^2	0.85	0.14	0.22	0.25	0.27	0.18
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Individuals whose partner change job in the same year in which they switch sector have been excluded. Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. See Figure 2 for more information.
Source: Own calculations based on register data from Statistics Denmark.

Table 11. Balance sheet components – controlling for partner's income, wealth and debt level (DKK 1,000)

Variables	(1) Pension	(2) Assets	(3) Non-mortgage	(4) Mortgage	(5) Housing	(6) Homeowner
POST	−2.150	0.628	−1.498	−6.373	−10.867*	−0.019***
	(1.320)	(1.206)	(2.145)	(4.633)	(5.772)	(0.007)
POST × *toPUBLIC*	0.140	−0.584	−0.712	8.651	8.154	0.019*
	(1.912)	(1.747)	(3.107)	(6.711)	(8.361)	(0.010)
TREND	25.045***	2.065*	3.737*	6.281	7.318	0.006
	(1.248)	(1.141)	(2.028)	(4.381)	(5.458)	(0.007)
POST × *TREND*	−2.326***	0.111	−0.325	5.263***	5.551***	0.006***
	(0.321)	(0.293)	(0.521)	(1.125)	(1.401)	(0.002)
toPUBLIC × *TREND*	−5.051***	0.471	0.259	−1.968	−2.704	−0.004*
	(0.421)	(0.385)	(0.684)	(1.478)	(1.841)	(0.002)
POST × *toPUBLIC* × *TREND*	3.670***	−0.453	0.839	3.454**	5.624***	0.005**
	(0.455)	(0.416)	(0.739)	(1.597)	(1.989)	(0.002)
Observations	52,789	52,789	52,789	52,789	52,789	52,789
R^2	0.85	0.14	0.22	0.26	0.28	0.18
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Control variables similar to baseline specification plus partner's income, wealth and debt level. Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. See Figure 2 for more information.
Source: Own calculations based on register data from Statistics Denmark.

Table 12. IV-regression results: effect of pension wealth on assets and liabilities, winsorized observations

Variables	(1) Pension	(2) Debt	(3) Mortgage	(4) Non-mortgage	(5) Assets	(6) Housing	(7) Net wealth
$Exposure_i$	1.263***						
	(0.032)						
Pension		0.390***	0.410***	−0.019	0.086**	0.500***	0.186*
		(0.096)	(0.095)	(0.039)	(0.042)	(0.101)	(0.111)
Observations	10,415	10,415	10,415	10,415	10,415	10,415	10,415
R^2	0.643	0.142	0.127	0.068	0.133	0.204	0.160
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic		91	91	91	91	91	91

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.
All outcomes have been winsorized at the 1st and 99th percentile. See Table 3 for more information.
Source: Own calculations based on register data from Statistics Denmark.

Table 13. IV-regression results: split by liquid assets

	Low liquid wealth (1)	High liquid wealth (2)
Pension assets	0.335**	0.441**
	(0.124)	(0.151)
Observations	4,757	4,756
R^2	0.18	0.13

Notes: Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01.
The dependent variable is total debt. The sample is split into two equally sized groups based on the ratio of liquid wealth to income in the year in which the individual first appeared in the data. Remaining specifications correspond to those in Table 3.
Source: Own calculations based on register data from Statistics Denmark.

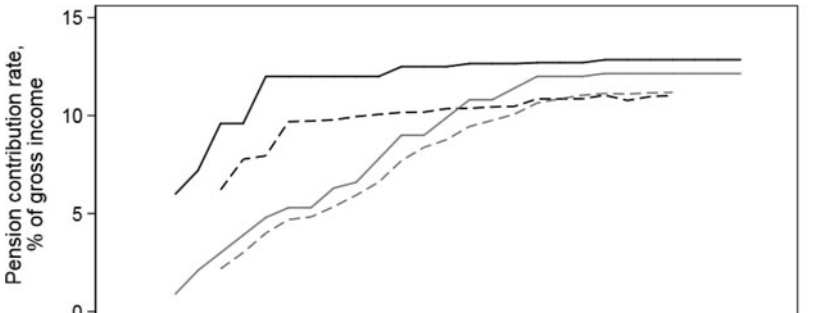
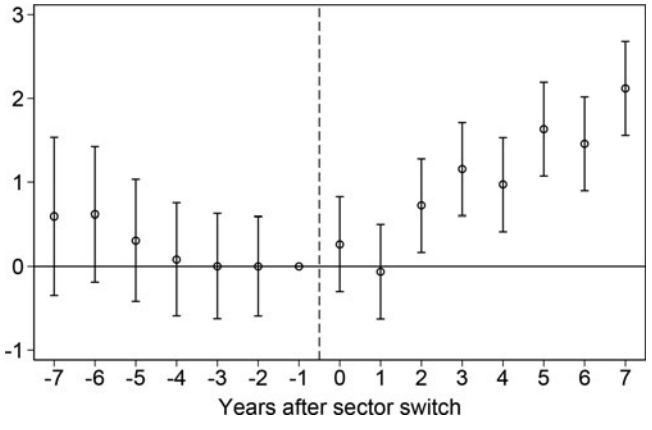


Figure 8. Pension contribution rates according to collective agreements and microdata.
Notes: Solid lines are identical to those presented in Figure 2, showing occupational pension contribution rates according to the collective agreements. Occupational pension contribution rates for the individuals in our sample are shown for employees in the public sector (black dotted line) and the private sector (gray dotted line), based on administrative registers. Differences in levels are caused by the fact that wage information in the administrative registers 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 according to collective agreements.
Source: Own calculations based on register data from Statistics Denmark.

Figure 9. Difference-in-differences plot: pension contribution rate (%).
Notes: The plot is based on a linear regression model where the dependent variable is pension contribution rates, which is regressed on interactions of a sector switch-indicator and time dummies. Each dot represents an estimated coefficient for the given year relative to the switching year marked by zero. The vertical bars represent the 5% confidence bands. The sample is confined to 7 years before and after switching sector as the error bars increase substantially in the tails, reflecting a declining number of observations, which makes the graphical representation of the coefficients challenging to read when exceeding this sample window.
Source: Own calculations based on register data from Statistics Denmark.



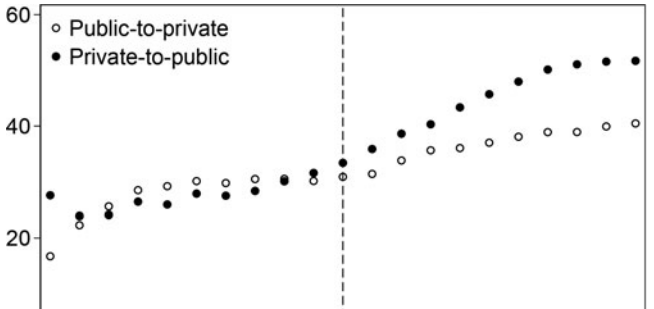


Figure 10. Homeownership rate across sector switches (%).
Notes: See notes in Figures 4a–4e.
Source: Own calculations based on register data from Statistics Denmark.

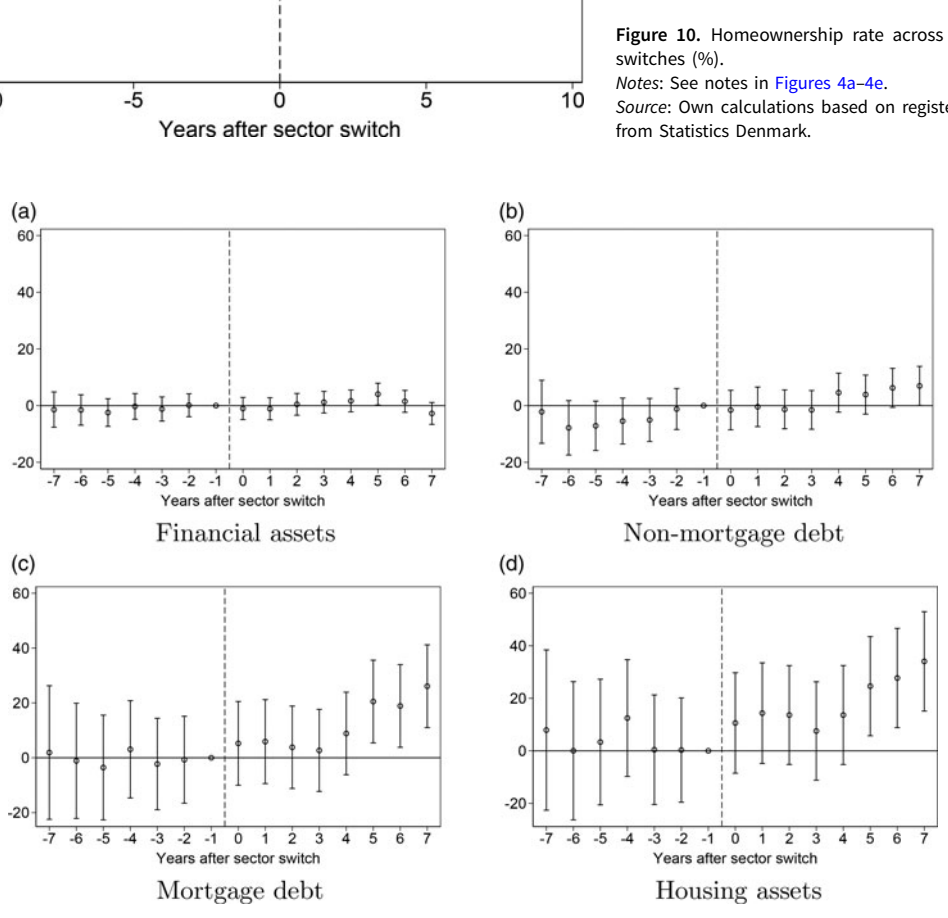


Figure 11. Difference-in-differences: annual changes in assets and liabilities (DKK 1,000).
Notes: The plot is based on a linear regression model where the dependent variables are stated in the sub figure titles. These outcomes are regressed separately on interactions of a sector switch-indicator and time dummies. Each dot represents an estimated coefficient for the given year relative to the switching year marked by zero. The vertical bars represent the 5% confidence bands. The sample is confined to 7 years before and after switching sector as the error bars increase substantially in the tails, reflecting a declining number of observations, which makes the graphical representation of the coefficients challenging to read when exceeding this sample window.
Source: Own calculations based on register data from Statistics Denmark.

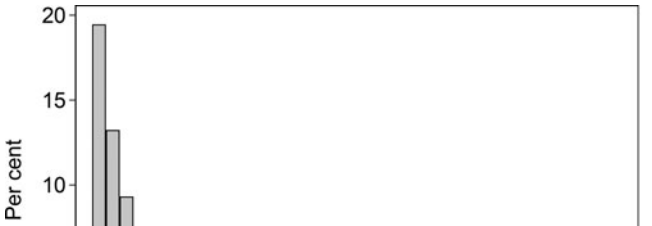


Figure 12. Distribution of excess public sector pension savings (exposure).
Notes: The exposure measure is constructed by stacking individual contributions for occupational pension accounts in years with public sector employment minus median contributions in private sector for similar jobs in that same year during 1995–2008, as per equation (2). The figure shows the distribution of exposure across individuals in the sample.
Source: Own calculations based on register data from Statistics Denmark.

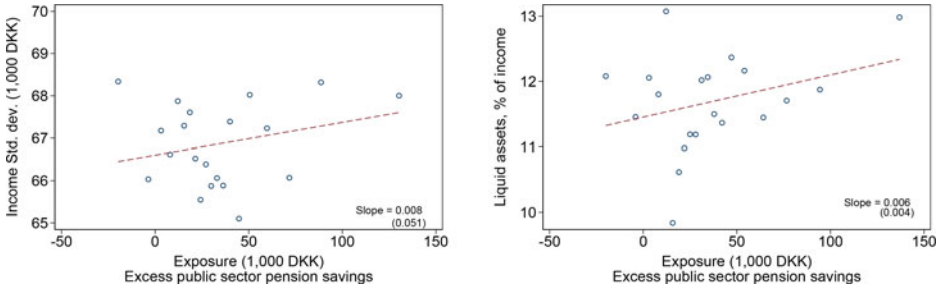


Figure 13. Correlation between exposure to excess pension savings and preference measures.
Notes: The figures show the correlation between the measure of exposure to excess pension savings and indicators related to individual preferences, namely the standard deviation of income and the ratio of liquid assets to income (measured in the first year in which the individual is observed in the sample). The two latter variables have been residualized using the set of controls from equation (3).
Source: Own calculations based on register data from Statistics Denmark.

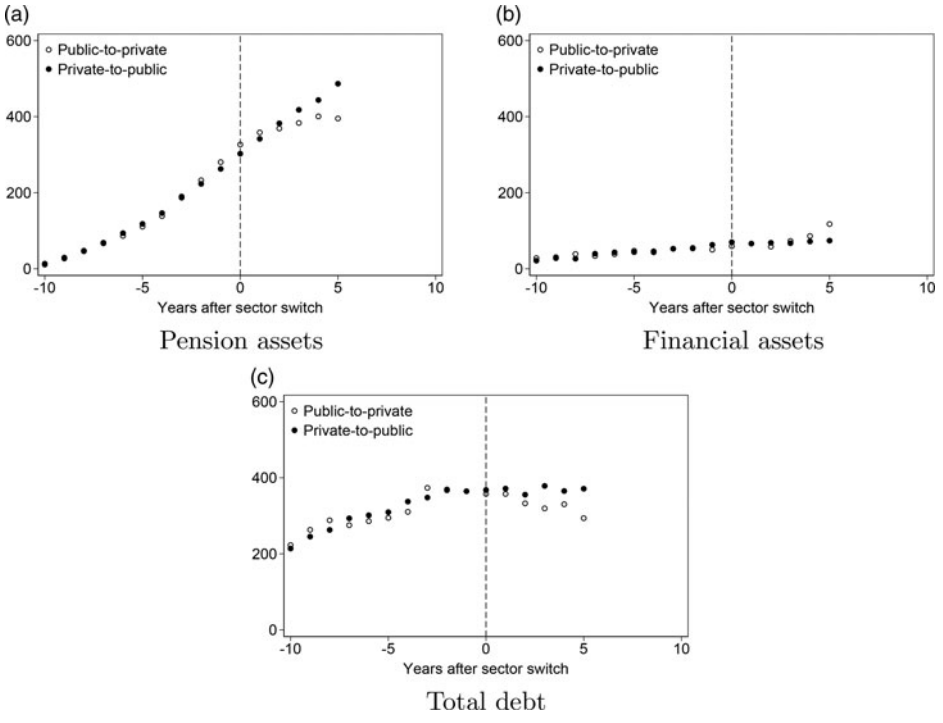


Figure 14. Developments in assets and liabilities across sector switches, 2009–15 (DKK 1,000).
Notes: The figures are constructed in a similar fashion as Figures 4a–4c but the numbers are based on calendar years later than 2009 where mandatory contribution rates are identical for private and public sector employees. See Figures 4a–4c for more information.
Source: Own calculations based on register data from Statistics Denmark.

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