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The Crowding-out Effect of Mandatory Labour Market Pension Schemes on Private Savings

Evidence from renters in Denmark

Søren Arnberg and Mikkel Barslund

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Abstract

This paper aims to estimate the crowding-out effect of the Danish mandatory labour market pension reforms begun in 1993 on the level of total household savings for renters. The effect is identified via a large panel of individual administrative records utilising the differences in speed, timing and sectoral coverage of the implementation of the reform in the period 1997 to 2005. Little substitutability was found between current mandatory labour market pension savings and private voluntary savings. Each euro paid into mandatory labour market pension accounts results in a reduction in private savings of approximately 0 to 30 cents, depending on age. This low rate of substitution is only, to a minor extent, explained by liquidity constraints. The results point to mandatory pension savings having a large effect on total household savings. Thus, pension reforms that introduce mandatory savings have macroeconomic implications.

JEL classification: D01, D91, H31

Keywords – Savings, Pension reform, micro panel data, first differences

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1. Introduction

The main source of pension savings in Denmark comes from mandatory pension contributions agreed collectively between labour market unions and employer organisations. For the majority of employees this system dates back to the beginning of the 1990s, when relatively small contributions were agreed upon as part of the wage-bargaining process between unions and employer organisations. The mandatory pension contributions have been increased on several occasions since then and are now a significant part of the remuneration package most employees receive. The size of these defined contributions varies among employees according to their occupation and the specific collective agreement covering their workplace. The contributions are mandatory in the sense that individuals are not allowed to opt out of the pension scheme if their workplace is covered by a central agreement. This system of individual mandatory pension accounts, where individual contributions are largely determined at the firm or industry level, is unique in international comparison, and its effect on individual savings behaviour has never been studied before.

This paper is concerned with the substitution between these mandatory pension schemes and private savings. In particular, we analyse the extent to which the Danish mandatory labour market pension schemes offset or crowd out private savings in other assets. The offset effect of mandatory pension contributions on other private savings has important implications for a range of policy issues. Specifically, for policy-makers in countries contemplating reforming the pension system from an unfunded pay-as-you-go system to a funded defined-contribution system, it is important to know the impact on total private savings and, hence, on national savings. Likewise, it has implications for the usefulness of mandatory pension schemes in increasing national savings rates in general. In addition, general mandatory pension contributions can – as has been the case in Denmark – be used as

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a business-cycle policy instrument, in which case, the dampening effect on the economy depends crucially on the offset effect on other private savings.

The mandatory pension accounts in place in Denmark share features with some voluntary IRAs (Individual Retirement Accounts) and the voluntary 401(k) pension schemes available in the US. As is the case for those, contributions into the Danish mandatory pension accounts are tax exempt and taxes are paid upon withdrawal at retirement. The mandatory accounts also enjoy preferred tax treatment on interest earnings, since these are currently taxed at 15%, which is lower than the range of 25 to 60% applicable to returns on other financial assets. Parallel to the mandatory pension accounts, individuals can open 'non-mandatory' pension accounts where contributions are voluntary. These accounts receive the same tax treatment as the mandatory pension accounts, and are, therefore, perfect substitutes for mandatory pension accounts. The central difference between the Danish mandatory pension accounts and, for example, 401(k)s is that, depending on an individual's place of work, the contribution to the Danish mandatory pension account is fixed. Furthermore, for some individuals, there are year-on-year changes in the absolute size of the contribution – as well as in the contribution rate (i.e. contributions as a percentage of gross wages). We explore these features to estimate the offset effect on other private savings of mandatory contributions.

The present paper is situated within two strands of related literature. First, there is the well-developed notion that changes in expected pension entitlements upon retirement, as, for example, resulting from a change in a general old-age pension provision scheme can affect other forms of private asset accumulation. Feldstein (1974, 1982) and, subsequently, Gale (1998) are prominent studies of the effect of changes in social security on private asset accumulation in the US. More recently Attanasio & Rohwedder (2003) looked at the same effect following a pension reform in the UK, and Hurd, Michaud & Rohwedder (2012) investigate the issue in a cross-country setting.[1] Second, this paper touches upon the literature on the effectiveness of savings incentives in raising, in particular, savings for retirement. A body of research has examined the effect of IRAs on total private savings (Poterba, Venti & Wise, 1996; Engen, Gale & Scholz, 1996; Hubbard & Skinner, 1996; Attanasio & DeLeire, 2002 and Chetty et al. 2012) with mixed results. Similar mixed evidence has come from research on the effect of 401(k) eligibility and contributions on private asset accumulation (Poterba, Venti & Wise, 1995; Pence, 2001; Benjamin, 2003 and Gelber, 2011).

For both changes in pension entitlements and the availability of tax-favoured savings accounts, it is difficult to infer the effect on the accumulation of other private assets from theory alone. In the case of public pension reforms that alter pension entitlements, a simple life-cycle framework without liquidity constraints and with perfect foresight suggests that a one euro change in the net present value of pension entitlements would result in a change in the optimal consumption path, such that the change in total net present value of current and future consumption would be one euro in the direction opposite to the change in pension entitlements. Thus, the size of the offset effect on current savings depends on the distance in time to retirement and, therefore, on age (Gale, 1998). However, if individuals are liquidity-constrained or their precautionary savings motives are strong, pension entitlements would

[1] Other studies include Alessie, Kapteyn & Klijn (1997) and Euwals (2000), which analyses the effect of defined benefit pensions on private savings in the Netherlands; Gustman & Steinmier (1999) on the effect of pension wealth on other wealth in the US, Japelli (1995); Attanasio & Brugiavini (2003) and Bottazzi, Japelli & Padula (2006) on the effect on private savings following pension reform in Italy; and Kim & Klump (2008) on the effect of social security benefits on private savings.

crowd out other private savings to a lesser extent than dictated by the simple model.[2] The offset effect might also depend on institutional settings if these are important in framing individuals' planning horizons. For instance, a more-comprehensive welfare state might induce individuals to make less detailed retirement plans than a less-inclusive public system.

Within the context of the life-cycle framework, IRAs and 401(k)s affect total private savings by altering the return on savings as a result of the preferred tax treatment of these accounts (Hubbard & Skinner, 1996). However, theoretically it is not clear whether the income or substitution effect would dominate, and thus, how individual savings should respond. Furthermore, it can be argued (outside the framework of the life-cycle model) that dedicated pension accounts from which withdrawal is more cumbersome and carries a penalty increase private savings because these resources are locked away, and therefore induce self-control in saving behaviour of individuals (Thaler, 1994).[3]

As indicated above, both strands of literature reach mixed conclusions on the effect on private savings. Feldstein (1974) found that an additional dollar of social security would offset 30-50 cents of private savings – roughly the same range as estimates reported by Hurd, Michaud & Rohwedder (2012). Gale (1998) found offset effects upwards of 80 cents per dollar. Attanasio & Rohwedder (2003) report offset effects roughly in the middle of those from Feldstein and Gale. Chetty et al. (2012) study the effect of mandatory pension contributions on total savings and total pension savings and report that roughly about 15% of individuals react to changes in the contribution rates. Turning to estimates of the offset effect on other private savings from IRAs and 401(k)s, they range from little or no offset (Poterba, Venti & Wise, 1995, 1996) to close to full offset (Engen, Gale & Scholz, 1996; Attanasio & DeLeire, 2002) with findings in between (Hubbard & Skinner, 1996; Benjamin, 2003).

While our analysis is closely related to the literature on the effect of IRAs and 401(k)s on other private savings there are two distinct differences. Since, as noted above, the mandatory pension contributions do not introduce any new incentives to save, because any mandatory pension contribution plan can be mimicked voluntarily, our findings will have to be attributed to liquidity constraints or precautionary saving motives if we stay within the confinements of the life-cycle framework.

The paper therefore adds to the literature in three ways. First, it provides estimates of the offsetting effect of mandatory pension contributions on private savings for Denmark. The only other study of the offsetting effect of mandatory pension contributions at the individual level that we are aware of is Chetty et al. (2012). They study the administrative records from Denmark but use a very different empirical setup to ours. They also find little evidence of crowding out which is consistent with our results. Thus, the two studies complement each other.[4] Second, it relates to the literature on the effect of savings incentives for pension

[2] This also applies in the case where individuals affected by the change in pension entitlements perceive it to be financed in part by a change in the amount of taxes they paid.

[3] See also recent contributions from Thaler and Benartzi (2004), Benartzi and Thaler (2007), Card and Ransom (2011) and Madrian (2012) on behavioural biases related to (pension) savings decisions.

[4] The empirical approach in Chetty et al. (2012) is different from our set-up on at least three accounts: 1) We utilise changes in the pension policies over time (changes in the coverage of the labour market pension schemes and in the pension contribution rates). Chetty et al. utilises the variation that comes from individuals changing jobs. Because pension contributions vary across firms, job changes often lead to changes in the pension contribution rates. 2) We study the substitution between mandatory pension savings and voluntary savings, whereas Chetty et al. analyse the share of individuals who react to changes in the contribution rates. 3) Our focus is on individuals who rent their homes,

saving by providing an estimate for how much pension savings accounts affect other private savings even without additional incentives to save. Third, by allowing the estimates of the offsetting effect of mandatory pension savings to vary between the different age groups, we account for the issue of the older age groups having a shorter time span to adjust to changes in the mandatory contribution rates.

We find little evidence of substitutability between current contractual mandatory labour market pension savings and private savings. Each euro paid into mandatory labour market pension accounts results in a reduction in private savings of approximately 0-30 cents depending on the age group in question. The low crowding-out effect of mandatory pension contributions on private savings is only, to a limited extent, explained by the presence of liquidity constraints. We find evidence that crowding-out is increasing as individuals approach retirement age. For the youngest cohort there is no evidence of any crowding-out, whereas the oldest group (50 to 54 year olds) dis-saves around 30 cents of voluntary savings for each euro of mandatory pension contributions.

The paper is organised in the following way. The next section gives an account of the Danish labour market pension system. Section 3 describes the data sources available and the limitations they imply. Section 4 is devoted to specifics on econometrics. Finally, sections 5 and 6 provide results and a discussion.

2. The Danish labour market pension schemes

During the 1990s the Danish labour market pension system was expanded to include the private sector, and, as a consequence, today the majority of employed people save for retirement. Labour market pension contributions are mandatory for workers employed in a firm for which a collective pension scheme has been negotiated. A collective pension scheme is either agreed upon as part of collective agreements between unions and employer associations or as an agreement for employees within an individual firm.[5] If a worker is employed in a firm for which a collective pension scheme has been agreed, the employer deducts a fixed percentage – corresponding to the agreed contribution rate – of the monthly wage and places the contribution in an individual pension savings account. Today, mandatory pension contribution rates typically range between 11 and 18% of the monthly wage, but it is possible individually to increase the pension savings rate above the mandatory contribution rate.

The development of the labour market pension system has resulted in an increase in total labour market pension contributions as shown in Figure 1, which shows total pension contributions divided by total wage income for all workers in Denmark. The increase in the total labour market pension contributions corresponds to increases in the total pension contributions. Even though mandatory pension contributions have increased markedly, the share of total employee remuneration that is paid into private contractual pension schemes is

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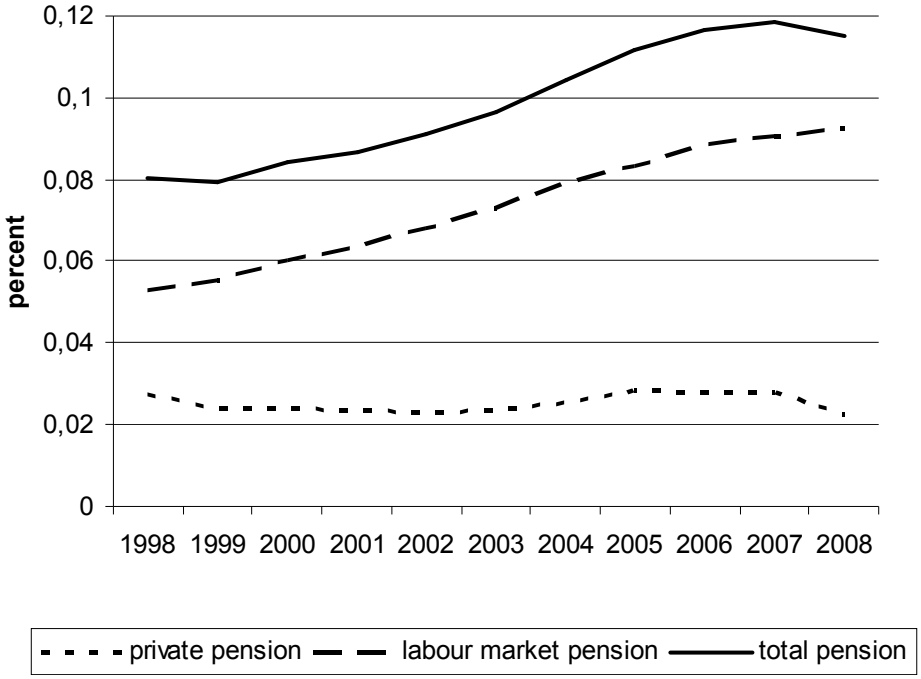
whereas Chetty et al. include real estate owners in their sample but restrict the analyses to individuals who change jobs. Our concern is that levels and changes in real-estate values are not well reflected in the Danish administrative records. The measure of total savings includes fluctuations in real estate values, because it is derived as the change in net wealth – including real estate wealth. During the data period there have been large changes in real-estate values. The value of real estate comes from the tax authorities and is measured with substantial uncertainty (see section 4 on data).

[5] The labour market pension contributions are mandatory for employees within a given collective agreement area, even for workers who have chosen not to join the union that has the right to negotiate. The implication is that the only way to avoid saving in a labour market pension scheme is to be employed in a private firm that is not covered by a collective labour market pension agreement.

almost constant during the period considered. Several explanations are consistent with these aggregate trends. Demography plays a role. The Danish population has been getting older in the time span considered. Nearing retirement probably induces awareness of the need to save for retirement. It might also be that the increase in mandatory pension contributions has generated a general increase in the willingness to save for retirement – an effect operating at the macro level. The explanation we pursue in this paper is that the developments shown in Figure 1 come about because substantial increases in mandatory contribution rates have lead to only a limited crowding out of savings in private pension schemes and in non-contractual savings.

Figure 1. Total pension contribution: Share of total wages, 1998-2008



Source: Statistics from SKAT and Statistics Denmark (Statistikbanken).

Even though labour market pensions have become more widespread, there are some groups that are not covered by labour market pension savings schemes (mainly non-organised and low-paid unskilled workers and high-paid, white-collar workers in small firms in the private sector, who are not covered by any collective agreement). In addition, the self-employed and those who are temporarily or permanently out of the labour force are not covered by a labour market pension scheme.

Table 1 shows the share of people in the workforce aged 30 to 55 years old who contribute to a pension scheme. The development of the mandatory labour market pension schemes has almost doubled the share of people who are covered by a labour market pension scheme. Thus, in 1988 only 37% of individuals between 30 and 55 years old contributed to a labour market pension scheme. In 2005, the share was 69%. The share of individuals contributing to a private pension scheme has remained at almost the same level during the observed period.

Table 1. Share of people between 30 and 55 years contributing to a pension scheme, 1988, 1995 and 2005

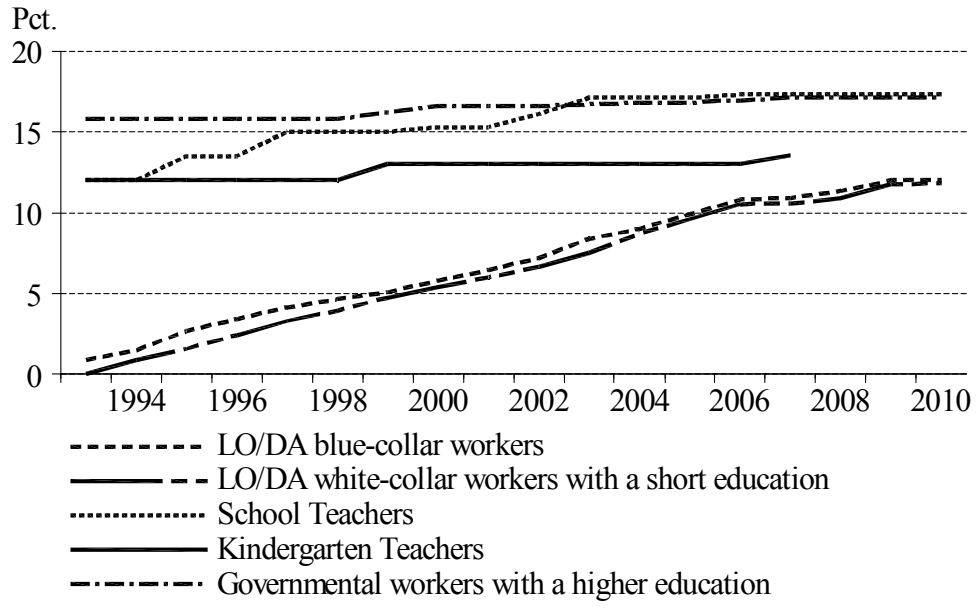
	1988	**1995**	**2005**
Labour market pension scheme	37	56	69
Private pension scheme	31	36	32
Any pension scheme	56	71	77

Note: Civil servants are not included.

Source: Calculations based on register data from Statistics Denmark.

Before 1990 labour market pension schemes were mainly reserved for workers in the public sector, but collective agreements between the Confederation of Danish Employers (DA) and the Danish Confederation of Trade Unions (LO) in 1991 resulted in an additional 520,000 blue- and white-collar workers with some post-secondary education or training being covered by a labour market pension scheme during the 1990s. This corresponded to about one-sixth of the Danish labour force. Figure 2 shows the pension contribution rates in the collective agreements for selected labour unions. Most notable is the development of the labour market pension system for members of the Danish Confederation of Trade Unions. When it was first agreed to develop labour market pensions for that specific area, the contribution rate was set at about 0.9% of the monthly wage, as shown in Figure 2. Over the following two decades, the contribution rate increased to about 12%. The lines representing the other union areas in Figure 2 all concern workers with a bachelor-degree level of education mainly employed in the public sector, where the labour market pension system was developed before 1993.

Figure 2. Contribution rates for Danish mandatory labour market pensions, 1994-2010



Notes: The contribution rates are agreed rates in the collective agreements. LO are the initials (in Danish) for the Danish Confederation of Trade Unions. DA are the initials (in Danish) for the Confederation of Danish Employers.

Sources: DA, LO, Confederation of Professionals in Denmark (FTF) and the Danish Association of Lawyers and Economists (DJOF).

For employees covered by a collective labour market pension scheme, changes in the contribution rates are agreed upon as part of the collective agreements at the national level. Thus, the changes in contribution rates are exogenously given for the individual worker. The parts of the salary that are liable to pension contributions vary. The basic salary and increments that are fixed are always liable to pension contributions. Whether one-off bonus payments and other forms of compensation are liable varies with the workplace. The default in the private sector is that bonuses are liable for pension contributions, whereas in the public sector it is more mixed. This is agreed upon between the workers' representative and the management of the workplace. Whether or not bonuses are liable for pension contributions, the prevailing practice is rarely changed. Thus, unless the workplace is very small, whether or not bonus payments are liable to pension contributions is exogenous to the individual worker.

For workers covered by mandatory labour market pension schemes that have been facilitated at the firm level, the default is to make the entire salary plus bonuses liable for pension contributions.[6]

The extent to which changes in contribution rates are anticipated is also an issue. We have observations for the period 1997-2006. Before that period collective agreements were agreed in 1995. In the public sector this was a two-year agreement (1995-1997) and for large parts of the private sector it was a three-year agreement (1995-1998). The next collective agreements were 1997-1999, 1999-2002, 2002-2005 and 2005-2008 for the public sector and for large parts of the private sector: 1998-2000, 2000-2004 and 2004-2007 (Statistics Denmark 2002, 2008). After a collective agreement is finalised, information on changes in the contribution rates during the agreement period is available. Thus, depending on the length of the agreement period, exact information about future changes in the contribution rates is publicised between zero and three years in advance.

In addition to the collectively agreed pension schemes, workers are obliged to make mandatory pension savings through the labour market additional pension scheme (known as ATP) and – for the years 1998 to 2003 – the special pension scheme (SP). Both are mandatory for employed and unemployed workers. However, the contribution rates are relatively small compared to the rates in the collective labour market pension schemes. Pension savings in the ATP-pension scheme are a fixed amount of between €150 and €450 a year. The SP pension scheme was introduced in 1998 as part of a counter-cyclical fiscal package and suspended in 2004. The contribution rate was 1% of wages for all workers during the whole period.

Mandatory labour market pension schemes are either pension by instalments or annuity pension schemes. In rare cases it is also possible to choose a capital pension (lump sum) scheme. However, in most cases, the mandatory payment schemes only offer one payment option. Voluntary private pension schemes, which are offered by banks and insurance companies, are also available. The voluntary private pension schemes offer all three options, that is, pension by instalments, annuity pension and capital pension. Thus, it is always possible to mimic mandatory labour market pensions with voluntary private pensions (Danish Economic Councils, 2008).[7]

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[6] There are no official records on this. However, the union secretariats of LO, HK and DJØF gave the impression (communicated via telephone) that the most common is that the whole salary is liable to pension contributions in private firms that have a labour market pension scheme for their workers.

[7] When the beneficiary dies, the spouse (if alive) and then their children become the beneficiaries of the pension by instalments and capital pension schemes. However, if the pension scheme includes an

Pension savings schemes are taxed favourably in Denmark. In general, income is liable to income tax. However, income that is paid into a pension savings account is not liable to income tax. Instead pension income is taxed. Interest and profits from funds locked up in a pension account are taxed at 15%, compared to a 40-60% for profits from funds in non-pension accounts. The tax rules do not distinguish between private and mandatory pension saving schemes. Thus, they are taxed exactly the same.

Besides the payments from the labour market pension schemes, a retired person is entitled to old-age retirement pension payments which amount to between €10,000 and €20,000 per year (gross of income tax) depending on the retired person's other income and marital status. In the time period considered here there has been no major change to the old-age retirement pension system.

3. Econometric specification

In this section we start with a reduced form model, which can be thought of as being derived from a simple life-cycle model (Alessie et al., 1997), although we do not emphasise this. The value of the life-cycle model in terms of understanding central features of the decision to save for retirement is increasingly disputed (Thaler, 1994; Benartzi & Thaler, 2007). Our estimating equation simulates an experiment where voluntary savings are compared for individuals who are identical with respect to other explanatory variables, but who differ in the share of their monthly wages that are mandated to contributions to their labour market pension account.

Consider an individual worker i at time t with mandatory labour market pension savings, s_{it}^{MP}. His additional voluntary savings consist of private savings locked-up for retirement, s_{it}^{PP}, and savings in free assets, s_{it}^{F} (e.g. bank accounts and financial assets). These three types of savings add up to total individual private savings. Voluntary savings, s_{it}^{V}, is defined as the sum of private pension savings and free savings:

$$s_{it}^{V} \equiv s_{it}^{PP} + s_{it}^{F} \tag{1}$$

Voluntary savings in period t for individual i are assumed to be a function of age (age_{it}), earnings (y_{it}) in the current period, total wealth (a_{it-1}), the present value of future expected earnings ($npvy_{it}$) and mandatory pension savings (s_{it}^{MP}):

$$s_{it}^{V} \equiv s_{it}^{V}\left(age_{it}, y_{it}, a_{it-1}, npvy_{it}, s_{it}^{MP}\right) \tag{2}$$

The arguments in the savings function would capture the features of a simple life cycle model. Individual voluntary savings are dependent on position in the life cycle (age), earnings, wealth, the expected value of future earnings, and mandatory savings. Our main interest lies in the effect of s_{it}^{MP} on s_{it}^{V}.

In order to arrive at an estimating equation we consider a linear version of equation (2) and eliminate the effect of age by estimating the equation for different age groups. This serves two purposes; it greatly reduces the number of potential parameters to be estimated since, in effect, parameters on earnings and wealth are potentially age dependant. In addition it will

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insurance element, the spouse usually only inherits a share of the payments rights. The children do not inherit the pension scheme when both spouses die. This applies to annuity pensions.

serve as a robustness check on the coefficient of the effect of s_{it}^{MP} on s_{it}^{V} across age groups. Thus,

$$s_{it}^{V} = \alpha + \beta_1 y_{it} + \beta_2 a_{it-1} + \beta_3 npvy_{it} + \gamma s_{it}^{MP} + \varepsilon_{it} \quad (3)$$

Identification and estimation

The administrative records (more on these below) contain information about annual savings in private voluntary pension schemes as well as annual mandatory pension savings. However, savings in other assets are not observed directly. Instead we use information about total wealth (excluding pension wealth) in period *t* and *t*-1 to derive annual savings in other assets. The change in total non-pension wealth can be written as:

$$a_{it}^{F} - a_{it-1}^{F} = s_{it}^{F} + r_{it}\, a_{it-1}^{F} \quad (4)$$

where a_{it}^{F} is individual *i*'s total non-pension wealth – also denoted as free assets - at ultimo time *t*, s_{it}^{F} is savings in free assets in period *t* as defined above, and r_{it} is the individual rate of return on the portfolio of total assets in period *t*. The return depends on the portfolio composition and can be written as a deviation from an average interest rate, *r*:

$$r_{it} a_{it-1}^{F} = (r + \bar{r}_{it}) a_{it-1}^{F} \quad (5)$$

We add equation (5) to equation (3) and thus redefine voluntary savings as contributions to private pension schemes and free savings plus the return from free savings. This yields:

$$s_{it}^{V*} = s_{it}^{V} + r_{it} a_{it-1}^{F} = \alpha + \beta_1 y_{it} + \beta_2 a_{it-1} + \beta_3 npvy_{it} + \gamma s_{it}^{MP} + r a_{it-1}^{F} + \bar{r}_{it} a_{it-1}^{F} + \varepsilon_{it} \quad (6)$$

We assume the $\bar{r}_{it}$'s are identical and independently distributed across *i* and *t* with a symmetric distribution with zero mean. This reflects that the total value of an individual's assets can be diversified in many ways, and that the expected excess return to any particular diversification is zero. The assumption rules out the possibility that individuals are able to consistently construct portfolios with higher returns than offered by the market rate, *r*.

Unfortunately, information about accumulated pension wealth is not available. This implies that our most parsimonious specification can be written as:

$$s_{it}^{V*} = \alpha + \beta_1 y_{it} + \delta a_{it-1}^{F} + \beta_3 npvy_{it} + \gamma s_{it}^{MP} + \bar{\varepsilon}_{it} \quad (7)$$

where $\delta = (\beta_2 + r)$ and $\bar{\varepsilon}_{it} = \beta_2 (a_{it-1}^{MP} + a_{it-1}^{PP}) + \bar{r}_{it} a_{it-1}^{F} + \varepsilon_{it}$. a_{it-1}^{MP} and a_{it-1}^{PP} are accumulated mandatory and private pension wealth, respectively, ultimo period *t*-1. The present value of future expected earnings, $npvy_{it}$, is approximated by dummy variables for education, industry of occupation and the interaction terms between the two.[8] The modified error term will be heteroscedastic due to the presence of $\bar{r} a_{it-1}^{F}$. Also, a_{it-1}^{F} may be endogenous because of the presence of private pension wealth, a_{it-1}^{PP}, and mandatory pension wealth, a_{it-1}^{MP}, in the modified error term.

[8] Note that, because all estimations are done on several different age groups, there is no need to include an age variable as a proxy for the present value of future earnings.

In addition, even with changes in the levels of mandatory pension contributions being exogenous at the individual level as argued in section 2, we still suspect the level of mandatory pension contributions to be endogenous in equation (7). Individuals with a greater proclivity to save for retirement are probably more likely to choose occupations – or jobs – where the mandatory pension contribution is higher relative to individuals with a lower proclivity to save. This would tend to bias γ upwards, when estimating equation (7) with OLS, that is, to show too little offset from mandatory pension contributions. To remedy these complications, we include an individual fixed effect in our preferred specification and additional control variables, X_{it}, including time dummy variables. This leads to

$$s_{it}^{V*} = \alpha + \beta_1 y_{it} + \delta a_{it-1}^{F} + \gamma s_{it}^{MP} + \lambda X_{it} + \eta_i + \bar{\varepsilon}_{it} \tag{8}$$

Identification of the parameter of interest, γ, comes from differences in the level of mandatory pension contributions across individuals and time. The identifying assumption is that conditional on the fixed effect and other explanatory variables, the mandatory labour market pension contribution is exogenous. Thus, we assume that individual proclivity for pension savings are constant over time and may, therefore, be approximated by a fixed effect. For a given age group the fixed effect causes the proxy for the present value of future expected earnings to be redundant in the estimation procedure (the transformations to eliminate the fixed effect cause the proxies to cancel out).

Estimation of (8) is complicated by the fact that a_{it-1}^{F} is present on the LHS as well as on the RHS, see equation 4 above, because lagged non-pension wealth is used to define non-pension savings in the current period. This gives equation (8) a partly dynamic panel structure. Simple within transformation or first-differencing to get rid of the fixed effect therefore leads to biased estimates without further measures.

We approach the estimation of (8) in two ways. First, we employ standard dynamic panel data methods using internal instruments in the form of further lags of a_{it-1}^{F} and transformations (Arellano & Bond 1991; Blundel & Bond, 1998 and Roodman, 2009). However, because the tests of instrument validity (over-identification tests) are very rarely satisfied in our specifications, we emphasise another option which – given an assumption of strictly exogenous covariates – establishes bounds on the parameter of interest without recourse to instrumental variables methods. To appreciate this, note that we can get an upper bound, denoted δ^U, and a lower bound, denoted δ^L, on the parameter estimate of the coefficient on lagged non-pension wealth, δ, by estimating (8) by OLS, respectively, a within fixed effect estimator. Now consider the following modified version of (8):

$$s_{it}^{MOD} = s_{it}^{V*} - \delta^m a_{it-1}^{F} = \alpha + \beta_1 y_{it} + \gamma s_{it}^{MP} + \lambda X_{it} + \eta_i + \bar{\varepsilon}_{it},\ m \in \{U, L\}. \tag{9}$$

If δ^m is a consistent estimate of δ, equation (9) can be consistently estimated by a within fixed effect estimator (or any standard method to eliminate the fixed effect, such as first-differencing). Let $\gamma(\delta^m)$ be the resulting estimate of the crowding-out effect from equation (9) given the value δ^m. Because $\gamma(\delta^m)$ is a monotone function of δ^m, effective bounds on $\gamma(\delta^{consistent})$ can be obtained by first estimating (9) with the within fixed effect estimator using δ^U to get $\gamma(\delta^U)$, and then repeating the process using δ^L to get $\gamma(\delta^L)$. Whether $\gamma(\delta^U)$ will be the upper or the lower bound on $\gamma(\delta^{consistent})$ depends on the correlations in the data, but is not important for our purpose. In our application this method generates very tight bounds on the estimated crowding-out effect.

In section 2 we noted that information about future changes in contribution rates may be published 0-3 years in advance in the beginning of a collective agreement period. Even though these changes are exogenous to the individual, it allows for the individual worker to change occupation if he dislikes the upcoming changes in contribution rates during the agreement period. This raises the concern that the estimates may be biased if the selection effects are not taken into account. However, we argue that this possibility is remote for two reasons. First, the costs of changing occupation are high if gained qualifications are not utilised in the new occupation or new qualifications would have to be obtained. For instance, during the agreement period 2002 to 2005, the contribution rates for school teachers were raised from 15.3 to 16.1% in 2002 and further to 17.1% in 2003. In the same period the contribution rates for kindergarten teachers were unchanged at 13%. School teachers who disliked the increases in contribution rates may have considered becoming kindergarten teachers instead. However, this would imply lower wages, because kindergarten teachers are paid less than school teachers. It would also imply not exploiting the gained qualifications as a school teacher (which is a 3½ year education in Denmark). Further, it would require gaining qualifications as a kindergarten teacher (which is a 2½ year education in Denmark). Thus, the costs of changing occupations are high.

Second, there is evidence that workers' knowledge about their pension affairs is incomplete even though this information is public. A Danish survey by Amilon (2008) presents evidence that Danish workers are unable to predict their future pension income. The study applies data about individual wealth, income and pension savings to estimate individual income when retired. These estimates are compared with survey data where the respondent answers questions about his/her expected income when retired. The results indicate substantial deviations between the respondent's expectations and the estimated pension income. However, respondents on the brink of retirement have smaller expectation errors than younger people. These results are supported by studies from other countries (Botazzi et al., 2006; Gustman & Steinmeier, 2001 and Dominitz et al., 2002).

4. Data

Our data are obtained from Danish administrative individual records covering the full population aged 18 and above over the period 1997 to 2005. It contains information on the demographic variables: age, number of children in different age intervals (0-2 years, 3-6, 7-9, 10-14 and 15-17 years), family status (single, married, co-habiting), detailed information on education, type and amount of employment throughout each year, and place of residence. Information on wealth and income covers gross income for each year and financial wealth at the end of each year, including the official assessment of the value of private dwellings. These official assessments of the value of private properties are conducted every two years in a more or less mechanical way, which leaves the official assessment trailing actual buying and selling prices by approximately two years. Due to the strong rise in property prices towards the end of the data period, this poses a real problem because home owners may perceive their home to be worth more than the value reflected in the data available. We therefore focus exclusively on renters, defined as individuals who do not own real estate and are not living with other individuals who own real estate. This definition excludes individuals living in families where one partner is named as the sole owner of the dwelling. This is done because married or co-habiting individuals whose partner figures as the owner of the dwelling might have a very different notion of their wealth than is reflected in the administrative records. The drawback is that persons renting a room in a private house where the owners themselves reside are also excluded. We perceive this to be a minor issue, however.

On the issue of pension savings (voluntary and mandatory), we have information on the total amount paid into mandatory labour market pension schemes, and the amount paid into voluntary pension accounts for each individual each year. In addition we have contributions to the special pension scheme (SP), which was in effect in the years 1998 to 2003. The contributions to the labour market additional pension scheme (ATP) are not in our data. This is unfortunate, but as explained above, the contributions to ATP are small in comparison to the agreed contributions in most labour market pension schemes.

All amounts paid into pension schemes are gross amounts, that is, they are taxable upon being paid out at the time of retirement. This issue is common in the literature since non-pension financial wealth is net of taxes (Hubbard & Skinner, 1996). However, unless your contractual pension wealth at retirement is very large, you are liable to pay only the lowest income tax rate on pension payouts. Since the mandatory labour market pension system was only established recently for most (private sectors) groups, it is not likely that many individuals will have large contractual pension wealth upon retirement – particularly not the older cohorts. Therefore, in order to compare (non-contractual) financial wealth with contractual pension wealth, an amount equal to 40% (approximately corresponding to the lowest effective personal income tax rate) of gross pension contributions is deducted to reach the net amount of pension savings. It is important to note that this particular issue does not affect our estimates of the effect of mandatory pension contributions on voluntary pension contributions since both are gross contributions and liable to the same tax rate when paid out after retirement. A related issue is how to treat means-tested pension benefits. Because retirement benefits are, to some extent, means-tested, some individuals are likely to face a higher effective tax rate on their pension contribution than the marginal tax rate, since on top of taxes paid on their private pension payouts they will face a reduction in publicly provided retirement benefits. We consider this to be a minor problem, particularly for younger cohorts. To affect our estimates it would require (young) individuals to: a) have a detailed knowledge of regulations related to retirement benefits, b) believe these rules will stay in place until they retire and c) have an ability to correctly estimate their pension wealth at retirement. In addition, it is emphasised that this will not affect our estimates of the effect of mandatory pension contributions on voluntary pension contributions.

Apart from confining the study to renters in the current year, the sample is limited in other respects as well. In particular, to get a reliable measure of the level of savings during each year, we exclude renters who owned property in the preceding year, due to the divergence between the market value and the value recorded in the administrative records described above.

Furthermore, only individuals between 30 and 55 years of age who are not registered as unemployed in the course of the year are included. These steps are likely to ensure that our results are not distorted by the presence of full or part-time students, individuals living off their wealth or on an early disabled pension scheme. In addition, apart from a few individuals, retirement is still some years off for people aged 55, so that the results will not be much contaminated by early retirement decisions.

Finally, we leave out individuals with a defined-benefit pension plan. The plan used to be widely offered to state employees in traditional state-run companies (e.g. the postal service, the former national telecommunications company, the national railway company) and persons in vital positions (e.g. the police force). The defined-benefit pension scheme is now only available to a few occupational groups. If a person was in a defined-benefit pension scheme in any year of the estimation period, they are not included in the sample. With these restrictions on the estimation sample, we have an effective estimation period from 1998 to 2005, with a total of around 1.5 million observations.

Table 2 shows summary statistics for the estimation sample. Voluntary savings include voluntary pension savings, free savings and the return from free savings. The average voluntary savings rate varies across time with small and positive savings rates in 2000 and small and negative savings rates in 1998 and 2005. This variation may come from fluctuations in stock and bond values. The mandatory pension savings rates increase across time as a result of the expansion of the labour market pension schemes. The increments in the saving rates are smaller than indicated in Figure 1. This is partly explained by differences in the definition of the savings rates between Figure 1 and Table 2. The macro savings rates in Figure 1 include income tax, whereas the pension contributions in Table 2 are net of income tax (40%). However, the increments in the average savings rate may also be smaller in our estimation sample of renters than for the whole labour force (as depicted in Figure 1). Despite the increase in mandatory pension savings, the average voluntary pension saving rates are almost constant across time, which may indicate limited crowding out. However, there is a decline in the share of workers who participate in a voluntary pension savings programme. The average non-pension wealth is small and negative reflecting the fact that many people have cash credits, car loans, other consumer loans, etc. For the average renter, the sum of these loans exceeds the sum of their free assets. In comparison, the average non-pension wealth (including real estate wealth) is positive in a sample including both home owners and renters, implying that the individuals in the estimation sample have smaller wealth. Table 2 show statistics for a constructed measure for liquidity constraints. About 65% of the individuals in the sample are liquidity-constrained according to our definition (liquid assets less than 25,000 Danish kroner).

Table 2. Summary statistics (Average, standard deviation in parenthesis)

Variables (selected years)	**Age groups**				
Voluntary savings (share of wage income)	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
1998	-0.012	-0.007	-0.009	-0.006	0.004
	(0.397)	(0.312)	(0.283)	(0.267)	(0.284)
2000	0.000	0.007	0.007	0.008	0.015
	(0.338)	(0.327)	(0.290)	(0.287)	(0.285)
2002	-0.009	-0.002	-0.003	0.002	0.006
	(0.333)	(0.279)	(0.283)	(0.267)	(0.292)
2005	-0.029	-0.017	-0.013	-0.004	0.000
	(0.415)	(0.336)	(0.328)	(0.296)	(0.320)
Mandatory pension contribution (share of wage income)[a]	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
1998	0.036	0.038	0.040	0.039	0.040
	(0.024)	(0.024)	(0.024)	(0.024)	(0.025)
2000	0.040	0.041	0.042	0.043	0.043
	(0.025)	(0.024)	(0.024)	(0.023)	(0.025)
2002	0.043	0.044	0.045	0.046	0.046
	(0.025)	(0.024)	(0.025)	(0.024)	(0.024)
2005	0.044	0.045	0.046	0.046	0.047
	(0.025)	(0.024)	(0.023)	(0.022)	(0.023)
Voluntary pension contribution (share of wage income) [a]	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
1998	0.005	0.005	0.006	0.007	0.014
	(0.018)	(0.019)	(0.02)	(0.034)	(0.049)
2000	0.004	0.005	0.005	0.006	0.011

	(0.017)	(0.018)	(0.03)	(0.029)	(0.042)
2002	0.004	0.004	0.005	0.005	0.010
	(0.014)	(0.015)	(0.02)	(0.024)	(0.048)
2005	0.004	0.005	0.005	0.006	0.009
	(0.017)	(0.02)	(0.021)	(0.027)	(0.053)
Non-pension wealth (thousands of Danish kroner)[b]	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
1998	-39	-37	-36	-30	-11
	(123)	(130)	(127)	(129)	(135)
2000	-43	-42	-40	-34	-15
	(128)	(136)	(135)	(134)	(143)
2002	-44	-42	-38	-32	-16
	(131)	(137)	(137)	(140)	(146)
2005	-55	-48	-43	-33	-21
	(140)	(147)	(147)	(151)	(159)
Wage (before tax, thousands of Danish kroner) [a]	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
1998	289	292	290	284	275
	(104)	(103)	(98)	(96)	(94)
2000	293	295	292	289	276
	(108)	(105)	(100)	(97)	(96)
2002	294	300	297	296	283
	(110)	(104)	(99)	(97)	(94)
2005	290	304	306	305	296
	(110)	(105)	(101)	(98)	(95)
Share participating in voluntary pension programme (1998-2005 average)[c]	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
1998	0.28	0.28	0.28	0.32	0.40
2000	0.26	0.27	0.27	0.28	0.36
2002	0.23	0.25	0.26	0.27	0.33
2005	0.22	0.27	0.27	0.28	0.33
Share liquidity-constrained (1998-2005 average)[c]	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
	64.73	66.96	68.30	67.51	61.34
Share women (1998-2005 average)	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
	0.48	0.51	0.55	0.57	0.65
Number of children in age intervals (1998-2005 average)	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
0-2	0.23	0.15	0.05	0.01	0.00
3-6	0.22	0.26	0.14	0.04	0.01
7-9	0.11	0.22	0.17	0.06	0.01
10-14	0.07	0.28	0.37	0.21	0.06
15-17	0.01	0.08	0.20	0.18	0.07
Number of observations	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
1998	60,872	37,145	27,569	25,848	28,745
2000	60,921	43,260	29,935	27,070	30,632
2002	60,059	47,659	32,908	28,201	31,834
2005	56,878	43,028	37,640	29,365	30,487

[a] Pension contributions are net of income tax (40%), while income tax has not been deducted from the reported wages.
[b] The net wealth includes all wealth except pension wealth, cash, durables (cars, boats, etc.), as well as stocks, loans, etc. that are not registered in financial institutions.
[c] A person with less than 25,000 kr. in liquid assets is defined as liquidity-constrained. Liquid assets include bank deposits and free assets (stocks, bonds, etc.).
Source: Calculations based on register data from Statistics Denmark.

5. Results

Before we turn to the impact of mandatory pension savings on total savings, we first present results for the impact on voluntary pension savings. Since voluntary pension savings are non-negative in nature, we employ a censored regression approach. Specifically, we estimate a censored version of equation (8) with only voluntary pension contributions as the dependent variable. Individual-level fixed effects are accommodated by utilising the estimator proposed by Honore (1992). This is done separately for each of the five age groups in order to accommodate varying coefficients among age groups. The reasoning behind this exercise is that the size of the crowding-out effect of mandatory pension savings on voluntary private pension savings gives an indication of the likely effect on total pension savings. As discussed in section 2, voluntary pension-savings contributions are nearly perfect substitutes for mandatory labour market pension contributions. Therefore, we expect that individuals are more likely, as a first step, to reduce voluntary pension savings in response to increases in mandatory pension contributions. Thus, if the effect on voluntary pension savings is small, we would expect the overall effect on private savings to be small.

Table 3. The effect of mandatory pension savings on voluntary pension savings

	Age groups				
	30-34	**35-39**	**40-44**	**44-49**	**50-54**
Mandatory pension savings (Coefficient estimates)	-.195*** (.01)	-.177*** (.01)	-.155*** (.01)	-.154*** (.02)	-.148*** (.02)
Other controls included	Yes	Yes	Yes	Yes	Yes
Observations[a]	476,664	348,100	257,638	220,591	244,808
Proportion non-censored	.24	.26	.26	.28	.35
Average marginal effect[b] Mandatory pension savings	-.05	-.05	-.04	-.04	-.05

Notes: The estimation method is censored regression with individual fixed effects (Honore, 1992). Other controls are time dummy variables, wealth primo each period interacted with time dummies, variables controlling for number of children and wage variables. All are defined as detailed in the data section. Standard errors are reported in parentheses. *** denotes significance at the 1% level.

[a] The number of observations differs from the number in the full sample since individuals without payments into voluntary private pension accounts in any year and individuals with payments in all years are excluded from the estimation procedure.

[b] The average marginal effects are calculated following Honore, 2008. Specifically, the average marginal effect equals the coefficient estimate multiplied by the proportion of observations that are not censored.

Table 3 presents the results from the censored regressions with individual fixed effects. The coefficient on mandatory pension contributions is rather similar across age groups and fairly precisely estimated. The coefficient on mandatory pension contributions should be interpreted as the average reduction in voluntary pension savings stemming from a one euro increase in mandatory pension contributions for an individual already making voluntary pension contributions. Thus, for individuals in all age groups who make voluntary pension contributions, a one euro mandatory pension payment crowds out less than 20 cents of voluntary pension contributions. The estimated coefficients on mandatory pensions are relatively low compared with a situation entailing full crowding out equivalent to coefficients close to minus one. The average marginal effect of mandatory pension contributions on voluntary pension contributions is markedly lower than the coefficient estimate and around 0.05 cent per euro for each age group. This is due to the relatively low share of uncensored observations.[9]

The level of faith one is inclined to attach to these results clearly depends on how much emphasis one puts on the bias caused by pension wealth being omitted in the estimation. Deriving – if possible – the exact conditions necessary to sign and further guess the magnitude of the bias is not a straightforward task in a semi-parametric non-linear framework. In order to argue that the bias is likely to be small or in line with the conclusion that the crowding-out effect is small, two arguments are offered. First, we reiterate the point of view that only a rather small minority of individuals pay close attention to their yearly pension statement.[10] The omitted variable bias is, therefore, likely to be small. Second, one can make the case that individuals – in particular young individuals – would adjust their voluntary pension contributions only marginally in response to changes in pension wealth. Changes in pension wealth over and above the pension contributions are entirely related to the overall performance of the portfolio of assets that constitute the pension wealth. Granting some sophistication to pension-saving individuals, one could argue that individuals – in particular young ones – choose their asset allocation according to some expected very long-term return.[11] An individual's expectations of the long-run performance of his/her portfolio would only change marginally when considering the most recent market returns. We are more inclined to trust the first argument, but in any case, we believe that the crowding-out estimates presented here are not qualitatively affected by the lack of data on pension wealth.

The results and discussions above suggest that the crowding-out effect of mandatory pension contributions on total savings is somewhat small and relatively far from generating a full crowding-out effect.

We now turn to the estimation of the full effect of mandatory pension contributions on total private savings. We first present estimates for both equation (8) (fixed effect, within transformation) and equation (9) (first differences) together with OLS estimates of the level equation (equation 8). As argued earlier, this last set of estimates is likely to show a substantial downward bias in the absolute size of the crowding-out effect, because the fixed effect can reasonably be expected to be correlated with mandatory pension contributions. Both the sets of within group fixed effect and first differences estimates are biased due to the

[9] We also estimated the model with a fixed effect (within estimator). The results were qualitatively similar and are available from the authors upon request.

[10] There is evidence from the US that people spend very little time on their financial decisions related to retirement benefits (Bernartzi & Thaler, 1999).

[11] In many mandatory labour market contribution schemes, it is not possible for the individual to choose an individual portfolio. One's long-run performance expectations of their assigned portfolio would only marginally depend on the most recent market returns.

dynamic panel structure. Our main interest is not in the coefficient on the potential dynamic variable, lagged non-pension wealth, but rather in the coefficient on mandatory pension contributions. The bias on this coefficient is of second-order importance and we expect it to be small in absolute size as is often found in Monte Carlo simulations (Arellano & Bond, 1991; Kiviet, 1995). Lastly, in order to corroborate this expectation, we present estimated bounds on the crowding-out effect following the method outlined in section 4.

Table 4 summarises the main results for each of the five age groups for different estimators. For brevity only the coefficients of the crowding-out effect are presented.[12]

Table 4. Estimated crowding-out effect for different age groups.

	Coefficient estimates of the crowding-out effect				
Age group	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
- OLS	.01 (.02)	.02 (.02)	-.00 (.02)	.00 (.02)	-.06 (.02)
- Fixed effect (within)	-.00 (.03)	-.09 (.04)	-.14 (.04)	-.29 (.05)	-.25 (.05)
- First differences (OLS)	-.01 (.02)	-.07 (.03)	-.16 (.03)	-.18 (.04)	-.23 (.04)
- First differences (GMM-IV)	-.03 .02	-.10 .03	-.18 .03	-.22 .04	-.27 .04
- Bounds on estimate	-.11 – -.01 (.03) – (.03)	-.16 – -.09 (.04) – (.04)	-.14 – -.13 (.04) – (.04)	-.29 – -.28 (.05) – (.05)	-.26 – -.25 (.05) – (.05)
- 95 pct. ci on bounds	-.17 – .05	-.24 – 0	-.22 – -.05	-.39 - -.18	-.37 – -.15

Note: Estimation of equations (8) and (9) (see main text).

Estimation of equation (8) by OLS leads to a parameter estimate that is virtually zero for all age groups. An exception is the oldest-age group of 50- to 54-year olds where the crowding-out effect at 6 cents per euro is significant. Within the group 'fixed effects', estimates yield more plausible results. The crowding-out effect rises with age from zero for the younger group (aged 30 to 34 years) to around 30% (or 30 cents per euro) for the 45 to 49 year olds. For the oldest age group the estimate is 25% offset. All parameter estimates are fairly precisely estimated with a standard error of around 5 cents or less.

Estimation of (8) in first differences delivers results of a similar pattern but generally with slightly lower crowding-out effects. Standard errors are small at around 4 cents or less. Our attempts to instrument the difference in lagged non-pension wealth in the first difference version of (8) lead to results for the crowding-out effect similar to those for the simple first difference model and the within group fixed effects estimators. But, as mentioned earlier, we were unsuccessful in getting the dynamic estimator to perform well in terms of accepting the over-identification tests.

We therefore turn to the results from the method outlined to establish credible bounds on our parameter of interest. As can be seen from Table 4, these bounds are very tight – particularly for the oldest age groups which exhibit the larger (in absolute values) crowding-out effects. For the youngest age group – those aged 30 to 34 – the central estimate lies between -.01 and -.11. This might be fairly wide, but it nevertheless shows that the crowding-out effect for this age group is rather low. For the 35- to 39-year olds, the bounds on the parameter are -.16 and -.09, respectively.

[12] A full set of all estimation results are available from the authors upon request.

For the three oldest age groups, the bounds on the crowding-out effect are so narrow that we virtually get a point estimate, with only one percentage point between the upper and the lower bounds. For the 40- to 44-year olds, the upper absolute value of the bound is -.29 and the corresponding number is -.29 and -.26, respectively, for the 45-49 year olds and the 50-54 year olds.

The central message we derive from the results presented in Table 4 is that the estimated crowding-out effects of mandatory pension contributions on total voluntary savings are fairly modest and compatible with the results obtained from looking at the effect on voluntary pension contributions only. Furthermore, the crowding-out effect is rising with age. Results are also consistent with those obtained in recent studies (Chetty et al., 2012, and Hurd, Michaud & Rohwedder, 2012),

Both the low crowding-out effects and the tendency of the effect to rise with age might be attributable to the presence of liquidity constraints if older cohorts are less liquidity-constrained than younger cohorts. Before reporting a range of robustness checks of the results, we therefore first look at the effect of allowing for different estimates of the crowding-out effect depending on whether an individual is considered liquidity-constrained or not.

To assess the potential impact of credit constraints on the estimated coefficients, equation (8) is augmented with a dummy variable measuring whether the individual is considered liquidity-constrained in a given year interacted with the mandatory pension contribution in that year. This set-up provides a separate estimate for the crowding-out effect for liquidity-constrained and unconstrained individuals. Table 5 presents the coefficient estimates for the five age groups when not being liquidity-constrained is defined as having cash, stocks and bonds with a value in excess of 25,000 DKK at the beginning of the year.[13]

Table 5. Estimated crowding-out effects for different age groups allowing for liquidity constraints

	Coefficient estimates of the crowding-out effect				
Age group	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
Liquidity-constrained	.04 (.04)	-.03 (.04)	-.10 (.05)	-.21 (.06)	-.15 (.06)
Not liquidity-constrained	-.02 (.09)	-.20 (.07)	-.32 (.09)	-.43 (.10)	-.44 (.11)

Note: The augmented version of equation (8) (see main text) is estimated with fixed effect (within). Being liquidity constrained is defined as having less than 25,000 DKK in cash, stocks and bonds at the beginning of the year. The coefficient on the liquidity non-constrained is the sum of the coefficients on the main variable, mandatory pension contributions and the dummy interaction terms as described in the main text. Standard errors clustered on individuals are in parenthesis.

Around a third of the individuals in the sample are liquidity constrained following the definition adopted here. This share is relatively stable across age groups with the 50 to 54 years old having a slightly larger share of non-constrained individuals (39%). Table 5 reveals that the low crowding-out effect is not an artefact of credit constraints, although non-constrained individuals do have a somewhat higher crowding-out in voluntary savings from mandatory pension contributions than liquidity-constrained individuals. Table 5 also confirms the structure of rising crowding-out with age.

[13] Changing the definition of being liquidity-constrained does not alter the reported results qualitatively. Specifically, we looked at cut-off values of 0; 10,000 DKK, 50,000 DKK, 75,000 DKK and two months gross wages.

In all specifications, the crowding-out effect rises with age – including the specification that takes account of liquidity constraints. We have no clear explanation for this. However, one could speculate that individuals in their 30s and early 40s may have higher incentives to save in order to buy cars, furniture and other durables that are convenient when establishing a home and/or family (the down-payment motive). This motive may be smaller once these goods have been acquired. Furthermore, recent empirical evidence suggests that older people have more accurate knowledge of their future pension entitlements than younger people and are thus better equipped to make crowding-out decisions (Amilon, 2008).

We conclude this section with a number of robustness tests. First, to check whether our findings are robust over time, the sample is divided into two, covering the periods 1998 to 2001 and 2002 to 2005. For each period, a fixed-effect within estimation is compared with the results from Table 4 above (row 2). Apart from revealing whether the results are period-specific (and therefore less general), it also relaxes the strain on the assumption that the fixed effect is time-invariant for a relatively long period.

A second concern is the treatment of individual returns to assets/investments (the $\bar{r}_{it}$'s in equation 6 above). Since an individual's deviation from the market return is tucked away in the error term of the estimating equation, the estimated crowding-out effect might be biased if there is a correlation between mandatory pension contributions and the excess return on investments. If more risk-averse individuals are simultaneously more likely to choose an occupation with large mandatory pension contributions and invest in low-risk assets with a corresponding lower average return, there will be a negative correlation between the error term and mandatory pension contributions if returns are primarily positive. Since individual asset levels are time-variant, this will only, to a minor extent, be captured by the individual fixed effect. In order to limit this concern, assets are divided into three groups (the most detailed level possible in the data): bank deposits, stocks and bonds and other assets. A regression is then run controlling for the three groups of assets separately, such that the assumption regarding returns is that the ability to earn results above the market result within each asset class is uncorrelated with other explanatory variables. In addition, different returns/interest rates are allowed for positive and negative bank deposits, and other assets.

Table 6 shows the results of the robustness tests. The two sets of estimates from the periods 1998-2001 and 2002-2005 are very similar and also close to the coefficients obtained from the full sample. Likewise, when we control for individual asset composition, the estimates are in line with those obtained in Table 4. Again, the crowding-out effect is qualitatively unchanged. These results lend credibility to our main result, emphasising that the crowding-out is low and rising with age.

Table 6. Robustness test: Estimated crowding-out effects for different specifications

	Coefficient estimates of the crowding-out effect				
Age group	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**
Split sample (1998-2001)	-.08 (.04)	-.08 (.05)	-.17 (.07)	-.25 (.07)	-.29 (.08)
Split sample (2002-2005)	-.06 (.05)	-.12 (.06)	-.17 (.06)	-.31 (.07)	-.31 (.08)
Controls for different asset types	-.01 (.03)	-.09 (.03)	-.13 (.04)	-.29 (.05)	-.26 (.05)

Note: All regressions are estimated with fixed effect (within). Standard errors clustered on individuals are in parenthesis.

6. Conclusions

This paper presents results from analysing the extent to which mandatory pension contributions are offset in other private savings. It is of interest because mandatory pension contributions have previously been used as an instrument for business-cycle stabilisation, and its effectiveness, as such, depends crucially on the offset effect. Further, the results may have wider implications for the effect on national private savings in countries changing from a pay-as-you-go unfunded pension system to a funded defined-contribution pension system similar to the one operating in Denmark today.

In a large sample of renters with data based on administrative tax records, we utilise the Danish mandatory labour market pension system to estimate the crowding-out effect of mandatory pension contributions on private savings. Econometric identification comes from the fact that the mandatory contributions are negotiated centrally and that different occupational groups have implemented the labour market pension system at different times and with differing speeds. Our findings suggest that mandatory pension contributions have an offset effect substantially smaller than full offset, indicating that mandatory pensions add substantially to national private savings. For the five five-year age groups considered, the central estimate of the crowding-out effect of mandatory pension contributions on private savings is always less than 30%, that is, a one euro mandatory pension contribution offsets 30 cents in other forms of private savings. For the younger age groups, the crowding-out effect is substantially smaller at around 0-15 cents per euro. These results are corroborated by estimations showing that the crowding-out effect is very small for voluntary private pension savings, which is the form of savings that is the nearest substitute for mandatory pension contributions.

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