

**MASTER**  
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DISSERTATION

How do public pensions crowd out private savings?

- Evidence from SHARE

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### *Abstract*

There has been much debate over the possibility that public pension wealth may discourage non-pension wealth. To evaluate the possible displacement effect of public pension wealth on other wealth, we employ retrospective micro-data from wave 7 of the Survey of Health, Aging, and Retirement in Europe (SHARE) while using Denmark, Portugal, Poland, and France as European country references.

First, we find that public pension wealth has a considerable displacement effect on the wealth from other sources, with a mean value of 29.5%.

Second, by adopting the Instrumental Variable method, we circumvent some of the most common measurement errors seen in previous research.

We estimate that one additional euro of public pension wealth is linked with a decline of 17 to 23 cents in non-pension wealth.

Finally, the crowd-out effect follows different patterns along the distribution of non-pension wealth across countries. There is heterogeneity in the pension-non-pension wealth offset depending on education, risk preference, and country.

Keywords: public pension wealth, savings, retrospective data, measurement error, crowd-out effect

### *Resumo*

Tem havido muito debate sobre a possibilidade da riqueza de pensão pública vir a desencorajar a riqueza não-pensional.

Para avaliar o possível efeito de deslocação da riqueza da pensão pública sobre outras riquezas, utilizamos micro-dados retrospectivos da Vaga 7 do Inquérito sobre Saúde, Envelhecimento e Reforma na Europa (SHARE), utilizando a Dinamarca, Portugal, Polónia, e França como países europeus de referência.

Primeiro, constatamos que a riqueza das pensões públicas tem um efeito de deslocação considerável sobre a riqueza de outras fontes, com um valor médio de 29,5%.

Segundo, ao adoptar o método da Variável Instrumental, contornamos alguns dos erros de medição mais comuns vistos em pesquisas anteriores.

Estimamos que um euro adicional da riqueza das pensões públicas está ligado a um declínio de 17 a 23 cêntimos na riqueza não-pensional.

Finalmente, o efeito de crowd-out segue padrões diferentes ao longo da distribuição da riqueza não-pensional pelos países.

Existe heterogeneidade na relação entre riqueza pensional e riqueza não pensional, em função da da educação, da preferência pelo risco e do país.

Palavras-chave: riqueza em pensões públicas, poupança, dados retrospectivos, erro de medição, efeito de crowd-out.

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### *1. Introduction*

In recent decades, the global fertility rate has declined, the death rate has increased, and the advances in medical science conceivably result in an increase in life expectancy, leading to increasing trend in population aging<sup>1</sup>. Since a decline in the labor force participation rate had the potential to erode the tax base for personal income taxes and social security contributions, the aging population has been reducing general government revenue, implying a large implicit fiscal gap, and thus threatening income adequacy in old age. The government in some countries has recognized this challenge. Most European nations have implemented incremental and considerable pension reforms to improve fiscal sustainability of public pension schemes, while ensuring adequate pension income in old age, mainly through altering pension parameters such as contribution rate and periods, statutory retirement age, and benefit indexation formula ([Hinrichs, 2021](#)). [Amaglobeli \(2019\)](#) suggests that workers' saving decisions might be affected by the features of the public pension system. The generosity and coverage of pension systems primarily determine the influence of public pensions on private savings. A more generous pension scheme will reduce workers' reliance on their savings. On the contrary, a decrease in benefit ratios and coverage rates may induce higher saving rates, since individuals must save for themselves to prevent a decline in living standards after retirement. As a result, for policymakers, understanding the effect that pension reforms will have on private savings is of great importance to evaluate the welfare effect of these pension reforms. However, according to [Leimer & Lesnoy \(1985\)](#), public pensions has little or no effect on private savings. Workers tend to be shortsighted in their retirement planning decisions and simply fail to accumulate adequate resources for retirement. This was an important reason

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<sup>1</sup> According to data from World Population Prospects from United Nations (the 2019 Revision): by 2050, one in six people in the world will be over age 65 (16%), up from one in 11 in 2019 (9%).

for the establishment of public pension systems. Therefore, since myopic agents were unable to save adequately during working years, public pension system would have no effect on private savings, as they never existed in the first place ([Garcia, 2019](#)). [Lusardi & Mitchell \(2017\)](#) prove that due to lack of financial literacy, for most consumers, planning for retirement and saving is a complex undertaking. Therefore, people want the government to force them saving for retirement by charging them payroll taxes, from which provide minimum benefits to meet retirement consumption needs ([Bodie, 1990](#)). Another reason in support of the existence of social security retirement system is that people may procrastinate in finding profitable investment strategies and implementing retirement plans, which could end up with too little retirement savings. As a result, the government is supposed to set deadlines on collecting wealth for retirement via special laws concerning tax incentives ([O'Donoghue & Rabin, 1998](#)). Indeed, Germany was the first nation in the world to adopt an old-age social security system in 1889, designed by Germany's Chancellor, Otto von Bismarck. At the beginning the system was targeted to extend the standards of living that was achieved during work life also to the time after retirement ([Boersch-Supan, 2006](#)).

Academic research has not yet arrived at a definitive answer to whether public pension wealth can fully offset private savings. [Feldstein \(1974\)](#) points out that from a theoretical point of view, the displacement effect of public pensions on private savings is ambiguous. Life-cycle model, the most well-known theoretical framework for analyzing individual saving behavior, predicts that pension wealth has fully crowd-out effect on private savings if households' savings motive is only for retirement ([Modigliani & Brumberg, 1954](#)). Nonetheless, this theory ignores other external factors that influence saving decisions, namely households' other savings motives, binding liquidity constraints, and the dynamics of the pension scheme. Mixed empirical evidence exists regarding the possible

displacement effect of public pensions on private wealth. Some authors suggest that heterogeneity of the crowd-out effect across individuals may exist depending on the borrowing constraints ([Gale & Philipe, 2006](#)), education ([Alessie et al., 2013](#)), and the composition of non-pension wealth ([Engelhardt & Kumar, 2011](#)). This study addresses this issue by evaluating the impact of public pension wealth on private savings. Following [Alessie et al., \(2013\)](#), we performed an econometric analysis through a micro-data of four countries in SHARE (The Survey of Health, Aging, and Retirement). The advantage of SHARE survey data is that it is a cross-country panel database of micro data containing information on the whole career of the respondent of retirees and old workers. Therefore, we can use these data to measure the sum of lifetime compounded income and public pensions. The previous study had to rely on proxy measures for past earnings, which may result in biases in estimation. The main non-pension wealth determinant considered in this study is the present value of compounded income. Some control variables such as education, risk preference, household composition, and gender are also included to account for the effect of heterogeneity of individual characteristics on wealth accumulation. Initially, the analysis is performed for the full sample and afterward for each country individually to track down the heterogeneity of pension-savings offset across the countries.

To sum up, our findings suggest one major conclusion: public pension wealth could crowd out private savings to some extent. However, due to the survey data's poor quality, our estimation will likely suffer measurement errors, endogeneity, and bias. Therefore, it is crucial to consider most of the different sources of bias that [Gale \(1995\)](#) mentioned during empirical specification. In this paper, we use the following:

- The pension wealth adjustment factor (Gale's Q) to adjust the lifetime consumption stream;

-Instrument Variable approach to circumvent endogeneity that comes from unobservable individual heterogeneity. We estimated a lower bound of displacement effect of 23%, significantly different from zero.

-A broad measurement of wealth component instead of a narrow measure of wealth-financial wealth to avoid underestimation of the true offset.

-Applying life expectancy to the calculation of future pension wealth. Life expectancy could cause omitted variable bias; (For example, two individuals who receive the same annual pension income and have the same retirement age might be expected to have different levels of pension and non-pension wealth if their life expectancies are different.)

-Instrument the potentially endogenous variable with statutory retirement age to limit individual's endogenous job preference (workers that prefer to earn good will choose a job which offers generous pension wealth. Meanwhile, they also accumulate more non-pension wealth)

However, we failed to circumvent the following:

-Using gross-of-taxes pension wealth, since the SHARE does not provide information about the net-of-taxes pension wealth, which could cause our estimates be underestimated;

-The measurement errors arise from pension wealth and lifetime income, which could cause our estimates be attenuated;

Also worth mentioning is that pension-saving offset is entirely subjective to an individual's wealth status and country of residence.

This paper aims to address whether disparities in pension wealth across individuals and countries contribute to heterogeneity in savings patterns.

This research also adds value to the existing literature. The combination of variables used in model specification enables us to analyze the pension-saving relationship more broadly, not limited to income or pensions, giving analysis unique characteristics.

Our study is organized as follows. Section two contains the related literature on pensions and aging theories. Section three presents the design of public pension schemes across countries and some statistical data to build background about public pensions. Section four is the sources and selection information about data. Section five analyzes the empirical model, and finally, section five sums up the work done with concluding remarks.

## 2. Theoretical framework: pensions and household savings

### 2.1 The origin of savings

Several researchers have sought to determine the effect of the design of the public pension system on household savings due to the fiscal unsustainability driven by rapid, unprecedented population aging in most European countries ([Herrera, 2020](#)). At the individual level, researchers and practitioners have generally acknowledged the importance of savings in ensuring household financial security during retirement and improving financial well-being. A country's macroeconomic performance may be affected by the amount of money its citizens save ([Harrod, 1939](#); [Romer, 1986](#); [Dooley et al., 1987](#)). At the macro level, national savings is one of the critical tools that countries utilize to finance domestic investment and absorb country-specific shocks, with implications for long-run economic growth and stability. Saving motives, which are a sort of intention, have been proven to affect households saving behavior ([Warneryd, 2000](#)). There are many motives for savings. The Life-Cycle Hypothesis (LCH) suggests that from a lifetime utility perspective, individuals build up their financial reserves during their productive years to finance their future expenditures and maintain the current standard of living during retirement, dissave after retirement and die without leaving any wealth. Accordingly, individual saving rates should follow a hump-shaped pattern over the life cycle, which is the retirement saving motive and the basis of the life-cycle model. ([Modigliani & Brumberg, 1954](#)). Previous work has primarily ignored that representative agents cannot make decisions simply depending on events or facts known with certainty in each stage of life (such as death date, future income, and inflation rate).

A few empirical studies have shown that household savings sometimes do not exhibit the hump-shaped pattern predicted by LCH, i.e., sometimes the elderly do not always follow the theoretically expected pattern of using down their savings, and indeed that many of the elderly appear to save part of their incomes ([Deaton, 2005](#)). [Leland \(1968\)](#) and [Hurd](#)

(1986) enriched the LCH by incorporating uncertainty into the model. Precautionary saving occurs when individuals are uncertain about their future incomes. Thus, they seek a reserve against all sorts of risks (unemployment, spouse death, health care expenditure, etc.) (Leland, 1968). The third one is that the bequest motive comes from altruistic parents' endeavor not to decumulate wealth to leave an inheritance to their descendants. (Hurd, 1989). This phenomenon is widespread in countries with pay-as-you-go (PAYG)<sup>2</sup> pension schemes, as parents (pensioners) try to compensate their children (taxers) with higher mandatory transfers derived from increasing pensions with their endowments. Finally, the enterprise motive occurs when people are motivated to save by the rate of return they may receive from business investments or speculative projects.

National savings consist of private savings by households and firms and public savings by the government. The behavior of each may be affected by changing demographic circumstances to different extents, but national saving is determined by household saving decision-making (Mason, 2001). Previous studies found substantial cross-country heterogeneity in the saving motives of households (Alessie et al., 1997; Harris et al., 2002; Johnson, 1999), which suggests that differences in parameters of the public pension system, cultures as well as differences in the level of development of financial sectors may affect household saving motives, therefore affect national savings. Amaglobeli (2019) indicates that the impact of public pensions on household savings depends substantially on generosity of the public pension system. With a less generous pension system featuring a low benefit ratio and low coverage ratio, retirees will rely more on their own savings to avoid a large drop in their living standards during retirement. Fan (2002) also found that Chinese and American households' saving motives varied by culture. Chinese culture emphasizes two core values: thrift and conservative, contributing to a positive attitude

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<sup>2</sup> Retirees covered by pay-as-you-go pension schemes receive pension benefits from the current employees and employers contributions or payroll taxes. Most public pension systems are PAYG and unfunded.

towards saving among the Chinese population. Lastly, a developed financial market can support stronger retirement saving motives. Households can diversify retirement-related risks by investing in different age-specific financial products (annuities, retirement income funds, long-term care insurance, etc.) ([Amaglobeli, 2019](#)).

The first step in this paper was to know the three main motives for household savings and the importance of savings. The following section will focus on the relationship between public pensions and household savings based on distinct economic theoretical frameworks.

### *2.2 Literature overview of the relationship between pensions and household savings*

The relationship between pension wealth and household savings is theoretically ambiguous. The Life-Cycle Hypothesis (LCH) suggests that from maximizing lifetime utility perspective, people accumulate wealth during their productive years to finance their future expenditures, maintain the current standard of life, dissave after retirement and die without leaving any wealth. Accordingly, increases in pensions are offset perfectly by a reduction in household other wealth ([Modigliani & Brumberg, 1954](#)). However, the theory fails to acknowledge the significance of uncertainty and borrowing constraints. [Hubbard \(1986\)](#) states that pensions positively affect household savings for households that face binding borrowing constraints due to the illiquid nature of pensions. [Cagan \(1965\)](#) discovered the recognition effect of public pensions on private savings: public pension plans force people who participated in pension plan to pay attention to the importance of savings for retirement and their retirement prospects for the first time. Therefore, public pension wealth may actually increase private savings.

In contrast, [Hubbard \(1987\)](#) found that social security benefits fell with higher saving rates, suggesting that pension annuities provide groups at the risk of insufficient retirement resources with insurance against an uncertain life span. Furthermore, [Feldstein](#)

[\(1974\)](#) concludes that pension has a dual impact on personal savings. For example, workers covered by pensions have more significant incentives to retire earlier, which leads to an extension of the retirement period over which accumulated assets will be spread, and overall savings will be increased. Pensions, on the other hand, might act as substitutes for other household assets, leading to a decline in personal savings. Therefore, the balance between these two forces determines the net impact of pensions on savings. According to [Bernheim \(1998\)](#), the elderly may accumulate non-pension wealth due to a lack of financial literacy. It is, therefore, difficult to predict the extent to which household savings offset pension wealth and how it may vary across households.

Previous empirical studies on the possible displacement effect of public pensions on private savings employ a variety of empirical methodologies, including measurement of pension wealth and lifetime earnings, household surveys, and econometric identification strategies. A study using U.S aggregate time-series data by [Feldstein \(1974\)](#) investigated the displacement effect of social security wealth (SSW) on private savings. He found that an increase in SSW of 1 dollar is likely to reduce private savings by a substantial amount—up to 50 cents, in the sense that social security serves as a substitute for household assets, especially for middle and low-income families. One criticism of much of this literature is that the exclusion of several pertinent variables in his consumption function specification will result in omitted variable bias ([Barro, 1979](#)). Barro combined the original consumption function with the unemployment rate and the government surplus (revenues fewer expenditures) as additional explanatory variables and concluded that the estimated coefficient of social security was economically significant. In contrast, the evidence did not provide statistical support for the hypothesis that social security depresses private savings. Nonetheless, [Feldstein & Liebman \(2001\)](#) indicate that the displacement impact may be inconsistent due to aggregation problems. Consequently, several studies have employed cross-sectional data to estimate the displacement effect of SSW on private savings (see, e.g., [Cagan \(1965\)](#); [Katona \(1965\)](#) ). [Gale \(1998\)](#) conclusively demonstrates

that the estimated displacement effect in these previous studies is biased toward zero (i.e., understates the offset between pensions and non-pension wealth), which is arisen from regressing non-pension wealth on cash wages and pension wealth separately. To remove this bias, he proposes an age-specific adjustment factor known as Gale's Q, calculated based on a worker's current age and years of service. The adjusted pension wealth measure (Q times pension wealth) will yield an estimated offset equal to the true offset. He found an estimated offset of 77 percent for a sample of U.S households in which the head is working full-time and aged between 40 and 64. In addition, households with saving incentive accounts or with 16 or more years of education show more offsets than other households. However, all the studies reviewed so far suffer from the fact that some unobserved heterogeneity in household saving behavior (e.g., the taste of savings; job preference based on pension generosity) can bias upward crowd-out estimates. [Engelhardt & Kumar \(2011\)](#) adopt the instrument-variable technique to circumvent this problem and use cross-sectional data on 51-61-year-old individuals from the Health and Retirement Study (HRS) in the U.S. They revealed that households with wealth at or below the median saw no crowd-out from pensions, whereas those with wealth in the higher quantiles experienced crowd-out of 30-75 cents. This finding may lead to concluding that if policies are enacted to boost pension wealth, particularly for low-income households, the total growth of household wealth will be approximately dollar-for-dollar. [Alessie et al., \(2013\)](#) have revealed that measurement errors have a detrimental effect on estimates as most studies use proxies for lifetime earnings. They may not be able to obtain an accurate measure of pension wealth. Consequently, two correlated measurement errors of pension wealth and lifetime earnings might lead to a spurious positive partial correlation between pension wealth and private wealth. To limit the effect of measurement errors, he uses retrospective data to measure the present value of lifetime earnings and expected pension wealth and employs a restricted model from a subsample of retirees. He concluded that each euro of pension wealth is associated with a 47 (61) cent loss in private wealth in South and Eastern countries before the sovereign debt crisis in Europe. Besides

the crowd-out effect of pension wealth on private wealth mentioned above, several studies have given insight into the effects of specific pension reforms. To estimate the saving rate equation derived from life-cycle models, [Attanasio & Brugiaviani \(2003\)](#) used a time series of cross-sectional data before and after the Italian 1992 reform, exploiting the key changes introduced by the reform to identify the displacement effect. They found that the estimated coefficients follow a U-shaped age pattern, in that the middle-aged households (40-50 age group) have about 40% degree of substitutability between pensions and private savings. In contrast, younger and older households have the lowest coefficient. Similarly, [Lachowska \(2015\)](#) uses the differential impacts of the 1999 Polish pension reform on different groups and times as a source of quasi-experimental variation in pension wealth and employs the difference-in-difference approach to assess the magnitude of public pension crowd-out. The findings indicate a statistically and economically significant crowd-out of -0.24 for highly educated and older households.

Considering all of this, the model developed in this study attempts to address the question of how do public pensions affect private savings and whether there exists cross-country heterogeneity in the crowd-out effect across countries.

### *3. Conceptual framework and statistical data*

#### *3.1 Overview of public pension schemes in Europe*

Different designs of pension benefit schemes across countries are perceived to influence older individuals' retirement income adequacy and a country's long-term financial sustainability ([Amaglobeli, 2019](#)). The average old-age poverty rate is defined as having an income below the median of national household disposable income. The average old-age poverty rate for men and women in the OECD countries equal 11.6% and 16.2% respectively in 2021 ([OECD, 2021](#)). The first-tier pension level (i.e., Basic, target, and minimum pension plan) offers social protection for the elderly and targets maintaining minimum living standards during retirement. ([OECD, 2021](#)). However, the sustainability of public pensions is under threat since the first baby-boomer cohorts are now reaching retirement age, along with steadily declining fertility rates over the previous few decades ([Bazzana,2020](#)). In developed countries, many governments have resorted to implementing significant pension reforms to avoid getting bogged down in budget deficits. To limit the generosity and coverage of public pensions, these reforms typically involve altering the critical parameters of the pension system, such as revising the benefit formula, raising the statutory retirement age, or tightening eligibility restrictions. This section aims to elaborate on the main features of the mandatory part of the retirement-income provision for the year 2021 for countries represented in the empirical analysis, namely France, Portugal, Denmark, and Poland. The reason why we choose these four countries are as follows:

Firstly, following the classification rules of welfare systems proposed by [Roosma et al., \(2012\)](#), we label France as Western European welfare state, Denmark as Northern European welfare state, Portugal as Southern European welfare state and Poland as Eastern European welfare state. [Roosma et al., \(2012\)](#) proves that different countries have

different, and possibly opposite attitudes towards the various dimensions<sup>3</sup> of the welfare state: Comparing to Western (France) and Northern European countries (Denmark), Eastern (Poland) and Southern European countries (Portugal) are unsatisfied with their welfare states' efficiency<sup>4</sup> and effectiveness<sup>5</sup>, and their intended outcomes-goals<sup>6</sup> and outcomes-policies<sup>7</sup>. At the same time, they believe that more government responsibilities in providing social services and further redistributions are necessary.

Secondly, all of them are OECD countries in Europe and their publicly provided earning-related pension schemes are pay-as-you-go (PAYG) schemes. However, their PAYG schemes follows four broad types: Portugal has the typical defined-benefit (DB) schemes, in which pension benefits are determined by the number of years of contributions, accrual rates<sup>8</sup> and reference wages<sup>9</sup>. Similarly, France has the defined-benefit scheme based on a point system. In point system, pension points are calculated by dividing earnings by the cost of pension point. The pension benefit at retirement is equal to the sum of acquired

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<sup>3</sup> [Roosma et al., \(2012\)](#) identifies seven dimensions of welfare state: welfare mix dimension (Should the state / market /family /civil society redistribute resources?), goals dimension (providing social security, imposing equality and promoting social inclusion through participation), range dimension (If government can be responsible for several social benefits), degree dimension (how much effort the government should expend redistributing in certain policy area), redistribution design dimension ( who should pay and who should benefit from welfare state) , implementation dimension (efficiency and effectiveness) and outcome dimension (outcomes-goals, outcomes-policies, outcomes-economics and outcomes-moral).

<sup>4</sup> i.e., how efficient the health care system and tax system are perceived ([Roosma et al., 2012](#)).

<sup>5</sup> i.e., if the government abuse ("many people manage to obtain benefits to which they are not entitled to") or underuse ("people get fewer benefits than they are legally entitled to") of welfare systems ([Roosma et al., 2012](#)).

<sup>6</sup>i.e., Do social benefits and services lead to a more equal society, less poverty and working-life balance? ([Roosma et al., 2012](#)).

<sup>7</sup> i.e., whether the policies are satisfactory with the state of health care, the standard of living of the old, of the employed, the provision of affordable child care services and young people's working opportunities ([Roosma et al., 2012](#)).

<sup>8</sup> i.e., the rate at which pension entitlements accrues.

<sup>9</sup> i.e., a measure of individual earnings.

pension points multiplied by point value ([Boulhol, 2020](#)). In Denmark, individuals are covered by funded define-contribution system (FDC), in which each employer, and some times employees, make regular contributions into the employee's retirement account. In principle, the employee chooses how his account is to be invested in some limited securities (bonds, stocks and money-market funds). The pension entitlement depends upon the market value of the assets held in the retirement account and the interest rate at retirement ([Bodie et al., 1988](#)). Poland has notional defined contribution scheme, in which pension benefits depends on lifetime contribution, notional rate of return<sup>10</sup> and life expectancy. Individuals contribute part of their earnings to their notional accounts during working life, and receive pension benefits that is divided by accumulated notional capital by average life expectancy at retirement ([OECD, 2021](#)).

According to the OECD's taxonomy (see [OECD, 2021](#)), two mandatory pension tiers serve two unique purposes. The first mandatory tier encompasses public programs designed to ensure protection for those vulnerable to poverty and the least well-off, for which pension entitlements are calculated independently of pensioners' past earnings. Many countries' first-tier pensions might include one or more redistributive components of three types: basic pensions, target pensions, and minimum pensions. First-tier pensions exists in all countries, and their structures and values are country-specific (see Table 1. a). For example, France has a contributory minimum pension based on workers' years of contribution ("contribution minimale") and a means-tested minimum income benefit for persons turning 65 (ASPA). The sum of benefits cannot exceed an annual ceiling of EUR 14129.88 in 2019. Pensioners in Portugal who have contributed for at least fifteen years and whose benefits fall below a certain threshold are eligible for annual minimum and non-tested targeted pensions (Pensão Social de Velhice). A basic pension based on a mean test and a targeted pension are available in Denmark. The latter needs additional

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<sup>10</sup> i.e., 100% of the growth of the covered wage bill, but not less than the price inflation.

requirements, such as having legal residency for at least 40 years. The former offers a benefit roughly equivalent to 18 percent of average earnings and is irrelevant with contributions. In addition, retirees experiencing severe financial hardship may qualify for a supplemental pension benefit, a personal allowance, and a health allowance. Among the four countries studied, Poland has the lowest adequate minimum pension amount, PLN 1100 per month (i.e., EUR 234.25).

Table 1.a. Structure of retirement-income provision based on mandatory pension schemes (Source: OECD, 2021, table 3.1)

	First tier			Second tier	
	Public			Public	Private
	Basic	Targeted	Minimum	Type	
France			√	DB+Points	
Portugal			√	DB	
Denmark	√	√		FDC	
Poland			√	NDC	

DB= Defined benefit; NDC= Notional defined contribution;FDC= Funded defined contribution  
Source: OECD (2021)

The second part of the mandatory public pension, which can be public or private, consists of earnings-related components designed to smooth consumption and maintain a standard of livings between working life and retirement. Table 1. b. summarizes the main parameters by the country for 2021.

Table 1.b. Parameters and criteria of mandatory earning-related pensions used by OECD pension models

(Source: OECD 2021, Table 3.4)

	DB schemes		DB,Points or NDC schemes		FDC or NDC schemes	Ceilings for pensionable earnings	
	Type of scheme	Nominal accrual rate(%)	Earning measures	Valorization rate	Indexation		Total contribution rate (%)
Portugal	DB	2.13[w]	B40	Max(25%w+75%p,p+0.5%	p,d (2)	12%	none
France	DB+Points	1.16	B25/L	p/w	p/p		1.08/8.62 (4)
Denmark	NDC					0 (1)	none
Poland	FDC		L	p,wb,g	p,w[c] (3)	19.50%	2.57

Note: Empty cells indicate that the parameter is not relevant. [w] = varies with earnings; B = number of best years; L = lifetime average; p = price inflation; w = growth of average earnings; wb = wage bill growth; d = discretionary valorisation/ indexation; [c] = valorisation /indexation conditional on financial sustainability; NDC= notional accounts; DB= defined benefits

(1) Denmark: typical contribution rate for quasi-mandatory occupational plans. ATP pension only enters the last column

(2) Portugal: indexation is higher relative to prices for low pensions and vice versa. Indexation rises with higher GDP growth.

(3) Poland: indexation is to price inflation + at least 20% of real average-earnings growth in the previous year.

(4) France: the first ceiling relates to the national pension scheme, the second to the main mandatory occupational plan (ARRCO)

20 OECD countries follow the defined benefit pension plan (D.B.), whose benefits are contingent upon the number of years of contribution, the accrual rate, and individual pensionable earnings. The earning measures used in the benefit calculation formula are the average of entire career earnings revalued in line with nominal earnings growth. In Portugal, benefits generally accrue over the best 40 years of earnings at an accrual rate<sup>11</sup> equal to 2% for each year of contributions. France has both a defined benefit and a point system. In the defined benefits scheme, the "régime général," pension benefits are 50% of the average of the 25 best years' earnings, with early times' earnings valorized in line with price indexation after a whole career. If an individual retires before reaching the full-rate pension age, the pension amount is decreased by 1.25 percent every missed quarter or by 5 percent per year. In the point system, the number of pension points earned per year is the value of the contribution divided by the cost of pension points. At retirement, people accumulate the number of points multiplied by the weight of points which can be converted into a regular pension payment. Pension-point value<sup>12</sup> is adjusted annually in

11 i.e., the rate at which benefit entitlements build up each year.

12 This was EUR 1.2588 in 2019.

line with the gross wage growth rate. In Denmark, the notional defined contributions scheme (NDC) consists of ATP and S.P., whose pension benefit is technically a guaranteed deferred annuity. At retirement, retirees can convert their accumulated notional capital into monthly pension payments by applying an annuity divisor (depending on the recipients' expected duration of the survivor's benefit, the survival probability, and life expectancy) to the accumulated life-long contributions valorized with the notional interest rate<sup>13</sup>. Notional interest rate is based on financial market returns in FDC schemes and notional interest rates in NDC schemes. Likewise, under Poland's funded defined contributions scheme (FDC), contributions paid into the mandatory pension plans are exempted from income tax, and (in a somewhat limited way) they can be inherited by the close relatives of the insured party upon death.

There are also differences in the gross replacement rate, which refers to gross pension entitlements divided by gross pre-retirement earnings. At the top of the range, low earners<sup>14</sup> in Denmark will receive a future gross replacement rate of 125% after a full career. At the range's bottom line, Poland offers a future gross replacement rate of 32% to low-income workers after a full career. The future gross replacement rate for low-income workers is 76.3% and 60.2%, respectively (see Table 1.c.).

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<sup>13</sup> , i.e., the percentage used to adjust past earnings in the NDC scheme.

<sup>14</sup> Here define as workers earning half of average worker earnings

Table 1. c. Gross pension replacement rate for low-income workers in mandatory schemes (Source: OECD 2021, table 4.1)

	Individual earnings,multiple of mean for men (women are different)	
	pension age	gross replacement rate (%)
Portugal	68	76.3
France	66	60.2
Denmark	74	125.1
Poland	65 (60)	31.8 (31.9)

In this paper, we use the elements of cross-country heterogeneity in the features of pension schemes as a source of identification to estimate the displacement effect of public pensions on household savings in the empirical model described in section 4.

### *3.2 Public pension wealth VS Household savings - a statistical overview*

As mentioned in the previous section, with the rapid growth of the population aging, public pension expenditures as a proportion of GDP are rising each year, which may have a detrimental effect on financial sustainability. In many countries, governments suggested that they should implement pension reforms. Some theories and research assume that private wealth would decline as public pension becomes more generous, while others foresee the opposite. However, before moving on to the model itself, one must first examine the statistical data to determine which hypothesis is most likely to be supported by previous evidence. We analyze the public pension benefits through the public expenditures in pensions in the percentage of GDP and the household savings through the household gross saving rate<sup>15</sup>.

<sup>15</sup> i.e., the sum of household disposable income and the adjustment for the change in pension entitlements minus household final consumption expenditure, divided by household disposable income.

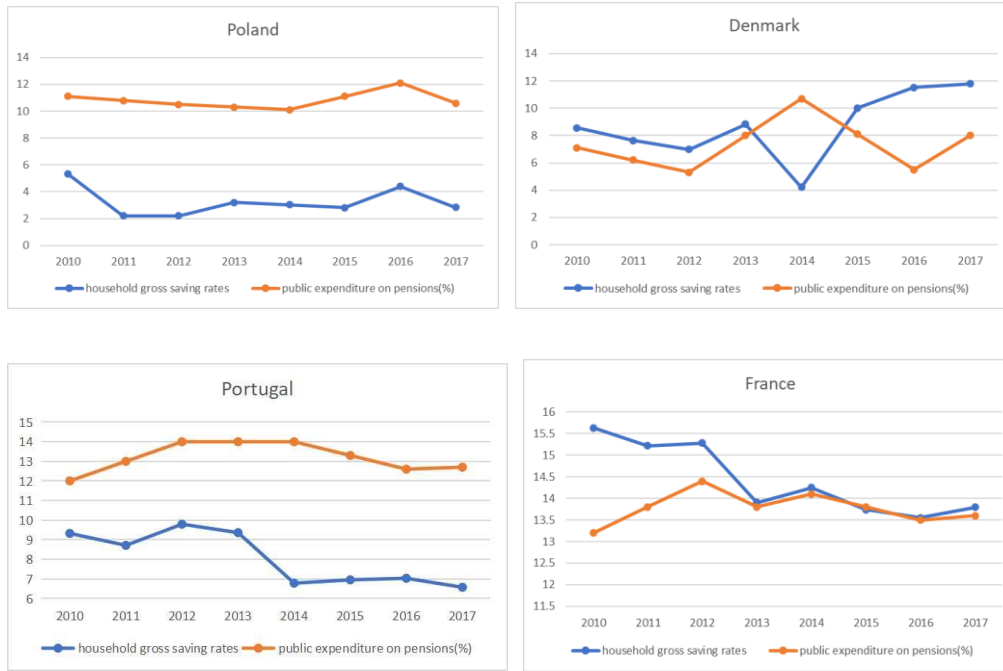
Figure 1 below illustrates the evolution of these two indicators between 2010 and 2017<sup>16</sup> in four OECD countries. Regarding the household gross saving rates, it is observable that there was a dramatic decline in Denmark, France, and Portugal through 2014. Pension expenditures as a share of GDP show a more consistent pattern across all the samples. Comparing the period's beginning and end allows us to conclude that, in the case of Portugal, the pension expenditure has increased while the household gross saving rate has decreased, which seems to align with the theory that public pensions have negative effect on private wealth. However, the two indicators are positively correlated in Poland, Denmark (before 2013), and France. Two distinct trends demonstrate that pension wealth is not the only factor determining the household saving rate. In the next part, we will analyze other external factors identified in the literature that influence household savings to reach unbiased conclusions.

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<sup>16</sup> OECD database only provides the data of percentage of public pension expenditures in GDP indicator between 2010 and 2017.

Figure 1: Comparative evolution of the household gross saving rate and the percentage of public pension expenditures in GDP in Poland, Denmark, Portugal and France from 2010 until 2017. Source: OECD

Database



#### 4. Empirical model

##### 4.1 Baseline specification

In the spirit of [Alessie et al. \(2013\)](#), we derive the empirical equation from a simple life-cycle model (See Appendix A). We estimate a reduced-form equation of wealth accumulation, where non-pension wealth at a given age is a function of earnings and Gale's Q-adjusted pension wealth. The baseline empirical model is as follows:

$$A_{i,c} = \beta_0 + \beta_1 Y_{i,c} + \beta_2 P_{i,c} + \gamma X_i' + \delta_c + \varepsilon_i \quad (1)$$

Where  $i$  and  $c$  are the individual index and country index respectively.  $A_{i,c}$  denotes non-pension wealth,  $Y_{i,c}$  denotes lifetime income,  $P_{i,c}$  denotes public pension wealth

(mandatory pensions for the private sector). Additional controls, represented by  $X'_i$ , take into account variations in preferences (i.e., risk attitude), demographic (such as gender, age groups, number of children, and education level), and other saving motives except saving for retirement (i.e., bequest motive).  $\delta_c$  is the country-specific effect and  $\varepsilon_i$  is the disturbance. The primary variable of interest is  $P_{i,c}$ , and  $\beta_2$  measures the impact of an additional euro of public pension wealth on households' non-pension wealth.

#### 4.2 Sample selection

The data of our empirical analysis is based on individuals' retrospective information about wealth, income, and socio-demographics collected from wave 7 (2016/17) of the Survey of Health, Aging and Retirement in Europe (SHARE) in France, Denmark, Poland, and Portugal. Wave 7 is the latest questionnaires wave which contains both each respondent's job-history section and financial situation section. From childhood health through professional occupations, SHARE's survey's methodology delivers comprehensive life-history data for all respondents.

We use the following rules for the sample selection:

- Individuals aged between 50 and 80 in the interview year of wave 7 work as full-time employees or self-employed for at least 20 years to exclude the disabled.
- Individuals have enough career information and at least two available wage points.
- Exclude retirees who did not report their pension wealth.
- Exclude employees who did not report their expected pension benefit when retired.

The compounded lifetime income and pension wealth are trimmed by 1% from above and below in each country to minimize the influence of outliers. The 1288 observations that make up our final sample included 921 people who have retired and 367 people who were actively working throughout the interview year for wave 7. Following the procedure

outlined in [Trevisan et al. \(2011\)](#), we present all monetary amounts in PPP-adjusted 2017 Euros, regardless of which currency or year they were earned.

### 4.3 Variables definition

The main variables in our study are as follows. See Appendix A for more details

Variables	Calculation rule
<p><i>Non-pension wealth: <math>A_{i,t}</math></i></p>	<p>Non-pension wealth=Net financial wealth+ Real wealth</p> <p>Net financial wealth=Gross financial assets-Financial liabilities</p> <p>Gross financial assets=Bank accounts + Bonds+ Stocks+ Mutual funds+ individual retirement accounts+ contractual savings for housing+ the face value of insurance policies</p> <p>Real wealth=the value of property minus mortgage+ the value of owned cars+ the owned share of own business</p> <p>Note: Following <a href="#">Christelis (2011)</a>, we employ multiple imputation techniques to deal with the missing value of each wealth component and replace them with five simulated versions.</p>
<p><i>Compounded lifetime earnings: <math>Y_{i,c}</math></i></p>	<p>Annual income= <math>(1+r)^{(2017-\text{start year of each job})} * \text{monthly wage after tax of each job} * 12</math></p> <p>During unemployment year: Annual incomes= <math>(1+r)^{(2017-\text{each unemployment year})} * 80\% \text{ last monthly wage after tax} * 12</math></p> <p>Total incomes from each job= (end year of each job – start year of each job) * annual incomes</p> <p>Compounded lifetime earnings= <math>\sum \text{Total incomes from each job} + \sum \text{Total incomes during unemployment}</math></p> <p>Note: For each individual, we construct a panel of annual incomes with one observation per year, from the first job until the interview year. Following <a href="#">Alessie et al. (2013)</a>, we use the linear interpolation between the first monthly wage on each job, the last wage of the main job, and the current wage for the employed to obtain the wage path. <math>r</math> (constant annual interest rate)=0.03, as in <a href="#">Hurd et al. (2012)</a>. For employed, the compounded lifetime labor income is calculated from period 1 (the start of the working career) to the wave 7 interview year. For the retired, the compounded lifetime income is calculated from period 1 to the first year before receiving pension entitlements.</p>

<p><i>Future labor income:</i> <math>Y(e)_{i,c}</math></p> <p>(Only for the employed sample)</p>	<p>Expected (statutory) retirement year= expected (statutory) retirement age – current age during interview +2017</p> <p>Future annual income= <math>(1+r)^{\text{(expected (statutory) retirement year-2017)}} \times \text{current wage after tax} \times 12</math></p> <p>Future labor income= <math>\sum</math> future labor income</p> <p>Note: When respondents did not specify their expected retirement ages, we use statutory retirement age instead. Statutory retirement age is 65 in Denmark and Portugal, 65 for men and 60 for women in Poland, and 62 in France. We assume constant real wages: <math>r</math> (constant annual interest rate) =0.03. We use country-specific 2020 life tables from the Human Mortality Database(<a href="http://www.mortality.org">www.mortality.org</a>) to weigh all future incomes by the individual probability of survival.</p>
<p><i>Pension wealth:</i> <math>P_{i,c}</math></p>	<p>For the retirees: Annual pension wealth = <math>(1+\rho)^{\text{(2017-each year of retirement)}} \times \text{monthly pension benefits} \times 12</math></p> <p>For still employed: Expected (statutory) retirement years= expected (statutory) retirement age- current age during employment +2017</p> <p>Future Annual pension wealth=<math>(1+\rho)^{\text{(each expected (statutory) retirement years-2017)}} \times \text{expected pension benefit when retired} \times 12</math></p> <p>Present value of lifetime pension wealth=<math>\sum</math> (Future) Annual pension wealth</p> <p>Note: Following Alessie et al. (2013), we assume constant real pension wealth and a discount rate (<math>\rho</math>) of 0.03 to adjust for inflation. According to Gale (1995), measuring the value of a pension without considering different life expectancies might result in bias. Therefore, we weighted all future pensions with survival rates from the Human Mortality Database and assumed a maximum age of 110</p>
<p><i>Gale's</i> <math>Q</math> (<math>\lambda, t</math>)</p>	<p>-Used for adjusting pensions</p> <p>-It is computed using equation (7) (See Appendix A), with <math>r=\rho=0.03</math> ( or <math>\lambda=1.03^{-1}</math>)</p>
<p><i>Additional controls:</i> <math>X'_{i,t}</math></p>	<p>-Used for capturing the heterogeneity of saving patterns across households, such as risk attitude to financial assets, receiving inheritances or not in the past, age groups, education level of the reference person, the number of children defined in four categories to allow for non-linear effects (0,1, 2, 3 and more) and gender (See Appendix B for detailed definitions).</p>

#### 4.4 Data statistical analysis

Table 2A presents descriptive statistics for the four main wealth variables obtained from the retrospective survey: non-pension wealth, financial wealth, risky financial assets, and housing wealth, as well as two main determinants of net worth: pension wealth and the sum of lifetime compounded incomes. The dependent variable is average non-pension wealth, which has a maximum value of 284,500 euros in Denmark and a minimum value of 121,200 euros in Poland. The probability of owning real estate property is higher in the sample due to our sample selection rules- individuals in our samples are wealthier and often homeowners than the country-representative figures. Lifetime compounded income data presents a relatively high standard deviation in Denmark, indicating high dispersion in this variable and that the distribution of wealth in Denmark is quite uneven. Concerning pension wealth, the maximum value of 263,800 euros was observed in Denmark, and the minimum of 89,400 euros was registered in Poland. This disparity might since occupational pensions in Denmark are typically a substantial share of pension incomes for retirees. Table 2B presents statistical samples for the additional variables included in this analysis. When the interview was being conducted, about 70 percent of the sample had already retired.

Table 2.a. Summary statistics. Non-pension wealth and pension wealth variables

	Total		Denmark		France		Poland		Portugal	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Non-pension wealth	20.80	15.44	28.25	17.92	26.09	18.03	12.13	9.06	20.42	11.54
Financial wealth	7.95	7.80	12.39	10.54	9.19	7.18	3.55	1.82	8.09	6.58
Probability of owning house	0.46	0.50	0.67	0.47	0.65	0.48	0.22	0.41	0.46	0.50
Housing wealth	21.02	14.37	27.89	16.45	11.21	4.79	8.46	5.05	18.47	11.04
Probability of holding risky assets	0.57	0.49	0.59	0.49	0.56	0.50	0.42	0.49	0.76	0.43
Risky financial assets	0.97	1.54	1.57	2.05	1.12	1.88	0.54	0.71	0.80	1.23
Adjusted pension wealth	16.22	8.94	26.38	6.04	18.24	6.18	8.94	2.13	13.74	8.09
Lifetime compounded income	78.73	46.12	102.17	57.30	87.09	50.02	53.50	22.08	80.86	37.21
Number of observations	1288		334		210		409		335	

Note: All quantitative wealth variables are in thousands of euros. Units: 10<sup>4</sup> Euro.

Table 2.b. Sample statistics: Control variables

	Denmark		France		Poland		Portugal		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Household size	2.4	1.10	2.39	1.08	2.33	1.01	2.32	1.01	2.36	1.04
Job situation (Yes: retired)	0.73	0.44	0.65	0.48	0.73	0.44	0.72	0.45	0.72	0.45
Age [50/54]	0.00	0.05	0.00	0.00	0.01	0.09	0.00	0.00	0.16	0.56
Age [55/59]	0.19	0.39	0.18	0.38	0.15	0.36	0.13	0.34	0.25	0.37
Age [60/64]	0.30	0.46	0.19	0.39	0.23	0.42	0.27	0.44	0.22	0.43
Age [65/69]	0.19	0.39	0.25	0.43	0.25	0.43	0.21	0.41	0.22	0.42
Age [70/74]	0.17	0.38	0.23	0.42	0.17	0.38	0.21	0.41	0.19	0.47
Age [75/80]	0.16	0.36	0.15	0.36	0.19	0.39	0.18	0.38	0.28	0.40
Nber of children=0	0.23	0.42	0.23	0.42	0.28	0.45	0.36	0.48	0.38	0.45
Nber of children=1	0.38	0.49	0.30	0.46	0.50	0.50	0.27	0.45	0.29	0.49
Nber of children=2	0.33	0.47	0.38	0.49	0.20	0.40	0.32	0.47	0.05	0.45
Nber of children ≥3	0.06	0.24	0.09	0.28	0.02	0.14	0.04	0.21	0.40	0.21
Primary or none education	0.25	0.43	0.22	0.42	0.52	0.50	0.51	0.50	0.22	0.49
Lower secondary education	0.22	0.41	0.27	0.44	0.20	0.40	0.20	0.40	0.19	0.41
Upper secondary education	0.28	0.45	0.23	0.42	0.15	0.36	0.13	0.33	0.20	0.39
Tertiary education	0.26	0.44	0.28	0.45	0.13	0.34	0.16	0.36	0.62	0.40
Received gift or inheritance more than 5000 euros (Yes)	0.26	0.44	0.24	0.43	0.23	0.42	0.31	0.46	0.29	0.44
High or very high risk	0.43	0.50	0.20	0.40	0.16	0.37	0.34	0.47	0.40	0.45
Average risk	0.16	0.36	0.50	0.50	0.50	0.50	0.45	0.50	0.32	0.49
No risk	0.41	0.49	0.30	0.46	0.34	0.47	0.21	0.41	0.54	0.46
Number of observations	334		210		410		335		1289	

## 5. Empirical Analysis

### 5.1 Baseline results

The estimation of the impact of public pension wealth on non-pension wealth is computed in this section using a pooled sample of four countries. We estimate equation (1) using Ordinary Least Squares (OLS), robust regression, and median regression, as [Gale \(1998\)](#) does. We use robust regression and median regression techniques to reduce the effect of outliers. The estimation of  $\beta_1$  and  $\beta_2$  (following equation (1)) are presented in Table 3.

Table 3. Effect of pension wealth on non-pension wealth-Full sample

	(1)	(2)	(3)
	OLS	Robust regression	Median regression
	Coef.	Coef.	Coef.
	(Std. Err)	(Std. Err)	(Std. Err)
Pension wealth	-0.406*** (0.060)	-0.295*** (0.041)	-0.301*** (0.049)
Income	0.042*** (0.008)	-0.046*** (0.006)	-0.022*** (0.007)
N	1,287	1,287	1,287
R-squared	0.374	0.461	0.734

Note: Robust standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Each regression includes age dummies, gender, household size, number of children, gift and inheritance received more than 5000 euros, education, risk preference, and countries as controls. Detailed results are available in Appendix C (Table 3A.)

According to [Engen & Gale \(2000\)](#), median regression helps analyze wealth data, which in our sample are highly skewed. Net non-pension wealth and financial wealth are explained variables ( $A_{i,c}$ ) in each regression. Age group, the number of children, gender, household size, education, risk aversion, an inheritance received as well as country-fixed effects are control variables.

The estimated pension wealth coefficient is negative (-0.406) and significantly different from zero. Controlling for other factors implies that public pension wealth reduces non-pension wealth by 40%. Robust and median regressions provide comparable findings, although being substantially lower than OLS estimates. The country-fixed effects are statistically significant in all models, suggesting cross-country heterogeneity in saving behaviors. Additionally, the coefficients for lifetime income and education variables are

significantly positive, which could be explained that these two variables are proxies for permanent income. Our result indicates that the coefficient for the less-educated individuals is not significantly different from zero. Whereas for those with a higher level of education, the pension-savings offset in absolute value terms is substantially higher and significantly different from 0. This result can be explained by the fact that people with higher levels of education have a higher probability of being financially literate and planning for retirement. In contrast, less-educated people have a lower likelihood of being financially literate and are, as a result, less able to correctly plan for retirement ([Laibson et al. \(1998\)](#)). We also look at the estimates for the risk preference and find for groups that take average financial risk; the coefficient is higher than that of the group "not willing to take any financial risk." It proves that risk aversion individuals tend to choose more savings, a conservative way of investment, as stated in traditional investment theory.

When financial wealth is taken as the dependent variable (Table 4), the robust and median regression estimator turns out to be non-statistically significant. According to the results of OLS estimation, every extra euro in public pension wealth reduces financial wealth by 9 cents. (and between 3 cents and 14 cents considering the 95% confidence interval), which is in accordance with Gale's statement- When assessing the crowding-out effect of pensions on narrow wealth measurements, it is possible to underestimate a significant portion of the true offset, as pension wealth can be accumulated over a long period, allowing for numerous opportunities to adjust holding of a wide variety of other assets ([Gale, 1995](#)).

Table 4. Effect of pension wealth on financial wealth -Full sample

	(1)	(2)	(3)
	OLS	Robust regression	Median regression
	Coef.	Coef.	Coef.
	(Std. Err)	(Std. Err)	(Std. Err)
Pension wealth	-0.090*** (0.029)	-0.014 (0.013)	0.002 (0.028)
Income	0.007* (0.004)	-0.001 (0.002)	-0.001 (0.004)
Observations	1,287	1,287	1,287
R-squared	0.428	0.429	0.643

Note: Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Each regression includes age dummies, gender, household size, number of children, gift and inheritance received more than 5000 euros, education, risk preference, and countries as controls. Detailed results are available in Appendix C (Table 4A)

## 5.2 Robust tests

The models above require each individual to respond similarly to pension wealth.

However, according to [Gale \(1998\)](#), other factors that affect pension-wealth offset likely vary across individuals. For instance, a preference for saving is expected to affect both pension benefits and household savings: persons with a high propensity to save are more likely to seek employment with generous pension plans, thus, pension wealth will be positively linked with the unobserved saving preference. Our estimation results so far might be attenuated due to unobservable individual heterogeneity that may influence pension wealth and savings behavior. On the other hand, an individual's retirement decision might be endogenous. Strong leisure preferences may lead to both early retirement and high rates of private savings to finance lifestyle expenses during retirement until becoming eligible for pension benefits. [Feldstein, 1974](#)). The increased saving rate would happen at the same phase of the life cycle when the implicit pension value is fast expanding, resulting in a positive link between pension wealth and savings. Since we selected the sample based on retirement status (71.5%), our estimates could be susceptible to endogenous selection bias, resulting in inconsistent results. Therefore, our sample is restricted to the age group 60 to 70, regardless of retirement status, since the average retirement age in our sample is 63.3. Another essential aspect of estimation that we need to be concerned about is measurement errors. [Alessie et al. \(2013\)](#) prove that due to poor

survey data quality and imputed missing values, pension wealth and the present value of past and future earnings are frequently measured with error. These two measurement errors are positively correlated, especially for the non-retiree sample, which may bias estimates away from zero. At the same time, measurement error in pension wealth could push estimates toward 0.

The distribution of expected retirement age varies significantly both within the full sample and between countries (as shown in Figure 2). Therefore, it is essential to instrument the pension variable with statutory retirement age first to avoid any endogeneity bias arising from heterogeneity in individual retirement decisions. Following [Engelhardt & Kumar \(2011\)](#), we assign each individual the country-specific statutory retirement age to calculate a "potential pension wealth variable," which is irrelevant to their expected retirement age. The scatter plots in Figure 3 demonstrate the correlations between individual expected pension wealth and the instrument, which is calculated using the country-specific statutory retirement age.

Figure 2. Distribution of expected retirement age in the full sample and each country's sample

Source: Wave 7 from SHARE, estimation sample. Missing data have been imputed by STATA hoc deck simulation method stratified by age, gender and income

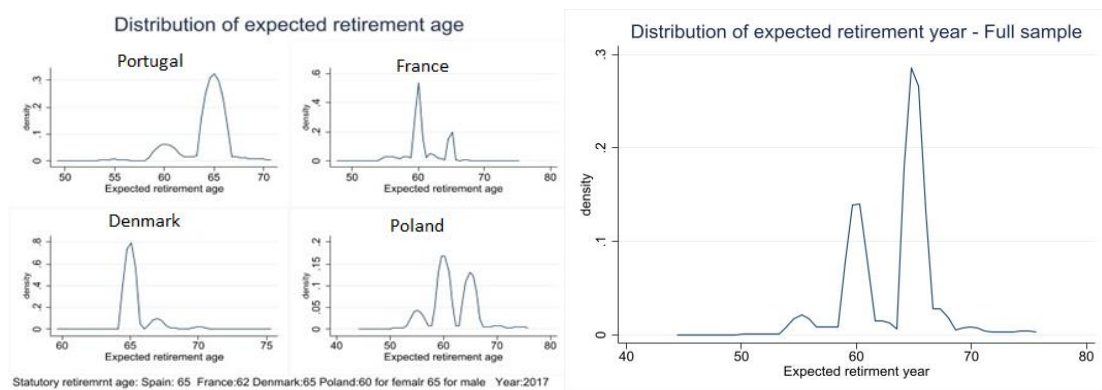
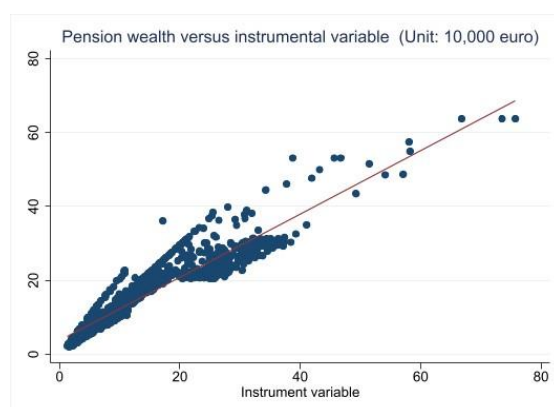


Figure 3. Pension wealth versus instrumental variable (Unit: 10<sup>4</sup> euro)

The robust test will be conducted through Instrumental Variable (IV) approach.

To correct the bias from endogeneity and measurement error, we use the Instrumental Variable approach (IV) to estimate equation (1) separately for the full sample, retired sample, and aged 60-70 sample. Table 5 provides the econometric results of the Instrument Variable regressions. We obtain a significant displacement effect, but it is much smaller (-0.23) than the one we obtained in robust regression (-0.406). The partial F-statistic of the first stage (OLS) regression exceeds the weak instrument threshold of 10. This result appears that our strategy of using instrument variables helps correct some of the attenuation bias arising from the measurement error in pension wealth. The estimated coefficient of pension wealth for the retired sample (-0.17) is lower than the full sample (-0.23) and significantly different from zero at the 5% level. It shows a pension-saving offset effect of 17% for retirees. Since the correlation between the measurement errors from pension wealth and lifetime compounded income should be considerably smaller for the retired group, the estimates should only be affected by attenuation bias resulting from measurement errors. As a result, it is feasible to interpret the estimates for the retired group as the lower bound of the true effect. The estimates, however, become insignificant when we constrain our sample to individuals aged between 60 and 70, implying that there might not be substantial sample selection bias in our sample.

Table 5: Effect of pension wealth on non-pension wealth: IV regression estimates

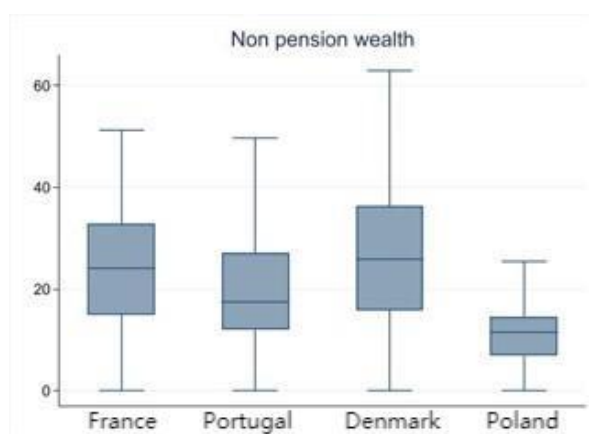
	(1) Full sample	(2) Retired sample	(3) Age 60-70 sample
Pension wealth	-0.231*** (-4.17)	-0.174** (-2.20)	-0.167 (-1.44)
Income	0.039** (2.56)	0.042*** (4.43)	0.029** (2.30)
Observations	1,287	920	609
F-statistic first stage	34.16	27.75	16.57

Note: Robust z-statistics in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Each regression includes age dummies, gender, household size, number of children, gift and inheritance received more than 5000 euros, education, risk preference and countries as controls. Detailed results are available in Appendix C (Table 5A, 5B)

### 5.3 Heterogeneity of crowd-effect across countries

The country-specific effects are statistically significant in all the previous baseline results, suggesting cross-country heterogeneity in saving behaviors. As previously stated, the difference between Denmark and Poland in non-pension wealth is enormous: the average non-pension wealth in Denmark is more than twice that of Poland. The country-specific non-pension wealth distribution is shown graphically in Figure 4. We use quantile regressions separately for each country in this section and report the estimates in Table 6.

Figure 4: Distribution of non-pension wealth across countries. Source: own calculation based on SHARE data



Our quantile estimate indicates that the savings of low-wealth respondents in Portugal would grow by 34.6 cents for every additional euro obtained from their public pensions. These respondents are considered to be in the lowest wealth quintile. The positive correlation between public pension wealth and private savings implies some complementarities between savings and pensions for people in the lower portion of the wealth. Policies that raise public pension wealth will also increase the private savings of low-wealth people and improve retirement-income adequacy. The pension-savings offset for higher quantiles in Portugal, Poland, and Denmark are generally lower than the offsets for median or low-wealth individuals. The reason may be that higher-wealth individuals, especially in Denmark, may be registered private voluntary pensions, considered financial assets in our sample.

Table 6: Quantile regression on each country: estimation of pension-savings effect

$\beta_2$	(1) Q1	(2) Mean	(3) Q3
France	-0.454 (0.198)	-0.215 (0.145)	-0.155 (0.198)
Portugal	0.346* (0.077)	-0.355*** (0.078)	-0.224*** (0.081)
Denmark	0.155 (0.096)	-0.0795 (0.077)	-0.005* (0.167)
Poland	0.611*** (0.213)	0.745*** (0.124)	-0.50*** (0.187)

Note: Dependent variable: non-pension wealth. Control variables: age, gender, education, income, number of children, household size, having received gift or inheritance of more than 5,000euros, and risk preference. Gale's Q factor adjusts pension wealth. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

## 6. Conclusion

In several European countries during the last few years, pension reforms that aim to make pension systems more resilient have been enacted as a direct consequence of the demographic shift toward older societies. As a result, the right of the elderly to adequate pensions and dignified old age is becoming a priority.

This paper adds to the existing body of information concerning the crowd-out effect of public pension wealth on non-pension wealth. Using retrospective information on past earnings and pension wealth from wave 7 of SHARE data, we are able to compute both present value of past and future incomes and pension wealth, providing convincing estimates of pension wealth for both working and retired people.

In our study, we have addressed the question: the extent to which public pension wealth crowd out non-pension wealth in cross-sectional data from four European countries with different features of public pension schemes. From the economic analysis performed, it was possible to conclude that for a pooled sample of countries, the displacement effect of pension wealth on non-pension wealth is significant at the mean. According to our robust regression estimate, each extra euro worth of public pension wealth may crowd out non-pension wealth by 29.5 cents and crowd out financial wealth by 9 cents. However, one must use extreme care when interpreting these results:

The potential for bias in our estimations remains, and the direction of bias is not revealed due to the correlated measurement errors in pension wealth and compounded lifetime earnings in non-retiree groups. Therefore, we estimate the model using a sample of retirees and older individuals. These individuals are less likely to have correlated measurement errors, and the direction of bias in their data is more likely toward zero. For the retired sample, the suggested displacement effect of pension on wealth is 17% and significant at the 1% level. This result may provide a lower bound to the true effect since the parameter estimates are attenuated.

Using Instrumental variable estimates has allowed us to account for the endogeneity that came from an individual's unobservable retirement decision in our model. Our IV estimate results suggest a displacement effect of roughly 23% for every additional euro of public

pension wealth, although estimated with less precision. These estimates indicate that pension wealth in Europe is a small but imperfect substitute for non-pension wealth.

We use quantile regression to investigate the heterogeneity of pension-non-pension wealth offset across countries and wealth distribution. Estimates reveal that the magnitude of the offset is higher for individuals at the bottom of the wealth distribution, which could be explained by the fact that as people in the lowest segments of the wealth distribution sign up for a pension system, they may save more.

The main limitation of this analysis is related to the difficulty in addressing issues of correlated measurement errors of pension wealth and the present value of past and future earnings since those two variables are computed from the same source (wave 7 of SHARE). To circumvent this issue, future research will have to add a different model which relies on the non-linearity of the pension formula and actual pension rules, such as the microsimulation model of pension wealth in distinct countries, to calculate the pension wealth and reduce the correlation of measurement errors.

Another limitation of our study is that other factors related to the heterogeneity in pension-wealth offset should be considered to obtain the most accurate result possible. For instance, an individual's confidence in the sustainability of public pension wealth<sup>17</sup>, marriage status, and credit constraint should be included as control variables in the further development of the study.

The implication of this study is that government policies should focus on raising pension wealth for low-wealth people to improve their old-age income adequacy and avoid old-age poverty. Governments should also contribute to expanding the range of financial instruments that will be useful for retirement savings and the provision of pension benefits, allowing less-educated or financially illiterate people to invest their savings in diversified financial products.

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<sup>17</sup> if an individual's confidence in the sustainability of pension wealth is destroyed, it is expected to have social insecurity and poverty; which explains why public pensions are mandatory.

As follow-up work, it would also be interesting to analyze this topic comparatively in developed and developing countries to assess if the relation holds. Future research would also take account of more control variables that determine saving behaviors, for instance, old-age dependency ratios, marital status, health condition and credit constraint.

*Appendix A. Background model*

Following [Engelhardt & Kumar \(2011\)](#), we derive the empirical equation from the discrete-time simple life-cycle model formulated by [Gale \(1998\)](#) with no uncertainty or liquidity constraint. We assume that the individual lives from period 1 until known death in time  $\tau$  and retirement occurs at period  $R$ . We assume that the within-period utility function of consumption exhibits constant relative risk aversion (CRRA), and  $\gamma$  is the coefficient of relative risk aversion. Moreover, we assume perfect capital markets with a constant real interest rate  $r$ , as [Alessie et al. \(2013\)](#) did.

The consumer maximizes lifetime utility:

$$\max_{C_\tau} \sum_{\tau=1}^T (1 + \rho)^{1-\tau} \frac{C_\tau^{1-\gamma}}{1-\gamma} \quad (1)$$

Subject to the intertemporal budget constraint:

$$\begin{aligned} \sum_{\tau=1}^T (1 + r)^{1-\tau} C_\tau &= \sum_{\tau=1}^T (1 + r)^{1-\tau} Y_\tau \\ &= \sum_{\tau=1}^R (1 + r)^{1-\tau} E_\tau \\ &\quad + \sum_{\tau=R+1}^T (1 + r)^{1-\tau} B_\tau \end{aligned} \quad (2)$$

Where  $C_\tau$  denotes consumption at age  $\tau$ ,  $Y_\tau$  denotes the income at age  $\tau$ ,  $E_\tau$  are the pre-retirement earnings,  $B_\tau$  is public pension benefits at age  $\tau$ , and  $\rho$  is discount rate.

By solving the first-order condition of equation (1), we get the consumption path:

$$C_\tau = C_1 \left( \left( \frac{1+r}{1+\rho} \right)^{\frac{1}{\gamma}} \right)^{\tau-1} \quad (3)$$

$$C_1 = \frac{\sum_{\tau=1}^T (1+r)^{1-\tau} (E_\tau + B_\tau)}{\sum_{\tau=1}^T \lambda^{\tau-1}} \quad (4)$$

Where  $\lambda = (1 + r)^{-1} \left( \frac{1+r}{1+\rho} \right)^{\frac{1}{\gamma}}$ .

We define  $A_t$  As non-pension wealth at the end of period t, which is equal to the cumulative difference between income and consumption:

$$A_t = \sum_{\tau=1}^t (1 + r)^{t-\tau} (Y_{\tau} - C_{\tau}) \quad (5)$$

By substituting (3) and (4) into (5), we get:

$$A_t = \sum_{\tau=1}^t (1 + r)^{t-\tau} Y_{\tau} - Q_t \sum_{\tau=1}^T (1 + r)^{t-\tau} Y_{\tau} \quad (6)$$

Where

$$Q(\lambda, t) = \frac{\sum_{\tau=1}^t \lambda^{\tau-1}}{\sum_{\tau=1}^T \lambda^{\tau-1}}$$

(7)

The so-called "Gale's Q" serves to adjust pension wealth, considering the time individuals have had since the introduction of the pension to adjust the life consumption stream ([Gale,1998](#)). Finally, by substituting (2) into (6), we can rewrite (6) as:

$$A_t = \sum_{\tau=1}^t (1 + r)^{t-\tau} y_{\tau} - Q_t \sum_{\tau=t}^R (1 + r)^{t-\tau} E_{\tau} - Q_t \sum_{\tau=R+1}^T (1 + r)^{t-\tau} B_{\tau} \quad (8)$$

The Gale's Q adjusted present value of the pension benefit at age t is given by  $Q_t \sum_{\tau=R+1}^T (1 + r)^{t-\tau} B_{\tau}$ . Taking into account the empirical counterpart of the components of equation (7), our baseline empirical specification to estimate is:

$$A_{i,c} = \beta_0 + \beta_1 Y_{i,c} + \beta_2 P_{i,c} + \gamma X_i' + \delta_c + \varepsilon_i$$

*Appendix B: Data source*

- *Dependent variable:  $A_{i,t}$  - Source: Wave 7 of SHARE*

We consider, in turn, various definitions of the dependent variable.

*Net (non-pension wealth):* real wealth (the sum of the value of property net of mortgage [variable name in the SHARE: ho024e], the value of owned cars [as051e]. and the value of owned share of own business [ as024e, as044].) plus net financial wealth.

*Net financial wealth:* all of the financial assets, excluding public and occupational pension schemes, minus the amount of debt that is still due [ as055e].

It includes bank accounts [as003e], bonds and stocks [ as007e, as011e], mutual funds [as017e], individual retirement accounts [as021e], contractual savings for housing [ as027e] and the face value of insurance policies [ as030e].

*Risky financial assets:* sum of bonds, stocks and mutual funds.

- *Compounded Lifetime earnings:  $Y_{i,t} = \sum_{\tau=1}^t (1+r)^{t-\tau} E_{\tau}$  - source: wave 7 of SHARE*

Lifetime earnings are measured as the sum of the present value of the gross first monthly wage of each job (for self-employed, the first monthly work income in self-employment) reported by the reference person in wave 7 of SHARE [ sl\_re021\_1, sl\_re021\_2, sl\_re021\_3, sl\_re021\_4, sl\_re021\_5, sl\_re023\_1, sl\_re023\_2, sl\_re023\_3, sl\_re024\_4, sl\_re024\_5].

- *Future labor income:  $Y(e)_{i,t} = \sum_{\tau=t+1}^R (1+r)^{t-\tau} E_{\tau}$  -source: wave 7 of SHARE*

We only calculate future labor income for the sample of employed people, assuming that real wages would remain the same. [sl\_re041\_]. It is presumed that persons will start their retirement in the year in which they report their expected retirement age to be [ ep106\_1] or the statutory retirement age (65 in Denmark and Portugal, 65 for men and 60 for women in Poland and 62 in France) if they failed to specify their expected retirement age.

• *Pension wealth*:  $P_{i,t} = \sum_{\tau=t+1}^L (1+r)^{t-\tau} B_{\tau}$  -Source: wave 7 of SHARE

Pension wealth is defined as the discounted sum of future pension benefits ([ sl\_re036\_1, sl\_re036\_2]) computed at the individual expected retirement age ([ ep106\_1 ]) for the retired sample; and calculated as the expected replacement rate([ ep109\_1 ]) multiplied by current wage ([ sl\_re027\_1, sl\_re209\_1 ]) for the employed sample.

• *Additional control variables* ( $X'_{i,t}$ ) – Source: Wave 7 of SHARE

**Demographic variables**: aged 55-59, aged 60-64, aged 65-69, aged 70-74, aged 75-80 ([ age\_int ]); an indicator of education ( ISCED  $\geq$  4, post-secondary or tertiary education; ISCED = 3, secondary education; ISCED  $<$  3, lower or primary education [ isced1997\_r]); the number of children (0, 1, 2, 3 and more ([ ch001\_ ])); gender of the respondent.

• *Risk attitude*: The following qualitative question is asked among respondents in the survey to obtain their attitudes toward risk: "Which of the statements on the card comes closest to the amount of financial risk you are willing to take when you save or make investments?" [ AS068]

1. Take substantial financial risks expecting to earn substantial returns
2. Take above average financial risks expecting to earn above average returns
3. Take average financial risks expecting to earn average returns
4. Not willing to take any financial risks

We group people who are answering (1) and (2) into one category (they make up less than 5% of the sample). We will choose category (4) as our reference group since it accounts for 78 percent of the total sample.

• *Gifts or inheritances received with value more than 5000 euros*: We take into account the intergenerational transfers with a dummy variable (Yes/No). [ ft015]

*Appendix C: Estimate results*

Table 3.a. Effect of pension wealth on non-pension wealth-Full sample

	(1)	(2)	(3)
	OLS Coef. (Std. Err)	Robust regression Coef. (Std. Err)	Median regression Coef. (Std. Err)
Pension wealth	-0.406*** (0.060)	-0.295*** (0.041)	-0.301*** (0.049)
Income	0.042*** (0.008)	0.046*** (0.006)	0.022*** (0.007)
Gender	0.738 (0.701)	0.551 (0.481)	0.174 (0.577)
Household size	-0.534 (0.338)	-0.178 (0.232)	-0.172 (0.279)
Age [55-59]	-0.263 (6.263)	1.429 (4.298)	4.790 (5.161)
Age [60-64]	-1.309 (6.232)	0.244 (4.276)	4.344 (5.135)
Age [65-69]	0.242 (6.237)	1.404 (4.280)	5.219 (5.139)
Age [70-74]	-0.016 (6.243)	1.395 (4.284)	4.845 (5.144)
Age [75-80]	0.878 (6.246)	1.043 (4.286)	5.213 (5.146)
Nber of children=1	1.177 (0.875)	0.213 (0.601)	0.052 (0.721)
Nber of children=2	2.695*** (0.931)	-0.113 (0.639)	-0.063 (0.767)
Nber of children≥3	-2.922* (1.755)	-3.712*** (1.204)	-3.443** (1.446)
Lower secondary education	2.115 (0.939)	1.329 (0.644)	1.333 (0.773)
Upper secondary education	3.045*** (0.995)	3.098*** (0.683)	2.983*** (0.820)
Tertiary education	9.293*** (1.008)	5.804*** (0.691)	6.530*** (0.830)
Inheritance more than 5000 euros	0.034 (0.790)	0.122 (0.542)	0.559 (0.651)
Portugal	-6.802*** (1.160)	-5.548*** (0.796)	-6.065*** (0.956)
Denmark	4.637*** (1.227)	4.359*** (0.842)	4.554*** (1.011)
Poland	-13.924*** (1.256)	-15.113*** (0.861)	-14.998*** (1.035)
Average risk	5.021*** (6.448)	3.496*** (6.448)	3.310*** (0.736)
No risk	11.559*** (0.894)	9.274*** (0.613)	8.567*** (0.736)
Observations	1,287	1,287	1,287
R-squared	0.374	0.461	0.773

Standard errors in parentheses. \*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 4.a. Effect of pension wealth on financial wealth – Full sample

	(1)	(2)	(3)
	OLS Coef. (Std. Err)	Robust regression Coef. (Std. Err)	Median regression Coef. (Std. Err)
Pension wealth	-0.090*** (0.029)	-0.014 (0.013)	0.002 (0.028)
Income	0.007* (0.004)	0.001 (0.002)	0.001 (0.004)
Gender	0.675** (0.339)	0.142 (0.149)	0.356 (0.324)
Household size	-0.235 (0.163)	-0.085 (0.072)	-0.094 (0.156)
Age [55-59]	-0.121 (3.028)	-0.673 (1.336)	0.822 (2.895)
Age [60-64]	-0.393 (3.013)	-0.737 (1.329)	0.450 (2.880)
Age [65-69]	-0.227 (3.015)	-0.334 (1.330)	1.105 (2.883)
Age [70-74]	0.213 (3.018)	-0.492 (1.332)	0.841 (2.886)
Age [75-80]	0.658 (3.020)	-0.292 (1.332)	1.237 (2.887)
Number of children=1	1.966*** (0.423)	0.448** (0.187)	0.692* (0.405)
Number of children=2	2.513*** (0.450)	0.719*** (0.199)	0.990** (0.430)
Number of children≥3	2.327*** (0.848)	1.024*** (0.374)	1.817** (0.811)
Lower secondary education	0.204 (0.454)	0.133 (0.200)	0.019 (0.434)
Upper secondary education	0.490 (0.481)	0.461** (0.212)	0.341 (0.460)
Tertiary education	3.595*** (0.487)	0.903*** (0.215)	1.338*** (0.466)
Inheritance ≥ 5000euros	-0.072 (0.382)	0.262 (0.168)	-0.044 (0.365)
Portugal	-1.632*** (0.561)	-0.777*** (0.247)	-0.780 (0.536)
Denmark	3.254*** (0.593)	1.114*** (0.262)	1.737*** (0.567)
Poland	-5.216*** (0.607)	-2.891*** (0.268)	-3.314*** (0.580)
Average risk	4.510*** (0.432)	1.042*** (0.191)	2.662*** (0.413)
No risk	8.086*** (0.452)	3.581*** (0.199)	5.166*** (0.432)
Constant	12.443*** (3.117)	8.253*** (1.375)	8.379*** (2.980)
Observations	1,287	1,287	1,287
R-squared	0.428	0.429	0.276

Note: Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. In median regression, standard error are based on 1,000 bootstrap replications.

Table 5.a. First stage estimates: Dependent variable: pension wealth

	Pension wealth
	Coef. (Std. Err)
Pension wealth with statutory retirement age	0.880*** (0.014)
Income	0.003* (0.002)
Gender	0.354** (0.161)
Household size	0.007 (0.078)
Age [55-59]	-2.486* (1.443)
Age [60-64]	-2.115 (1.436)
Age [65-69]	-3.233** (1.438)
Age [70-74]	-3.848*** (1.440)
Age [75-80]	-3.565** (1.440)
Number of children=1	-0.437** (0.202)
Number of children=2	-0.755*** (0.214)
Number of children $\geq 3$	-0.649 (0.404)
Lower secondary education	-0.131 (0.216)
Upper secondary education	-0.140 (0.229)
Tertiary education	-0.786*** (0.231)
Inheritance received more than 5000euros	-0.0793 (0.182)
Portugal	-1.343*** (0.265)
Denmark	-3.421*** (0.317)
Poland	-3.501*** (0.275)
Average risk	-0.0372 (0.206)
No risk	0.377* (0.215)
Constant	8.912*** (1.473)
Observations	1,287
R-squared	0.901

Note: Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 5.b. Effect of pension wealth on non-pension wealth: IV regression estimates

	(1) Full sample	(2) Retired sample	(3) Age 60-70 sample
Pension wealth	-0.231*** (-4.17)	-0.174** (-2.20)	-0.167 (-1.44)
Income	0.039** (2.56)	0.042*** (4.43)	0.029** (2.30)
Gender	0.617 (0.86)	0.114 (0.15)	0.782 (0.75)
Household size	-0.578* (-1.76)	-0.150 (-0.40)	-0.854* (-1.67)
Age [55-59]	-0.498 (-0.19)	-1.044 (-0.18)	
Age [60-64]	-1.456 (-0.58)	-1.437 (-0.24)	
Age [65-69]	0.027 (0.01)	-0.649 (-0.11)	
Age [70-75]	-0.243 (-0.10)	-0.641 (-0.11)	
Age [76-80]	0.638 (0.25)	0.255 (0.04)	
Number of children=1	1.110 (1.55)	0.745 (0.75)	0.476 (0.37)
Number of children=2	2.768*** (2.87)	2.927*** (2.84)	3.155** (2.21)
Number of children ≥3	-2.617 (-1.45)	-2.864 (-1.45)	-3.933 (-1.45)
Lower secondary education	2.251** (2.57)	1.292 (1.21)	2.500* (1.80)
Upper secondary education	3.113*** (3.62)	2.541** (2.20)	2.929** (1.97)
Tertiary education	9.520*** (8.59)	10.434*** (9.01)	8.586*** (5.78)
Inheritance received more than 5000euros	-0.004 (-0.01)	-0.024 (-0.03)	-0.454 (-0.39)
Portugal	-5.993*** (-4.65)	-5.441*** (-3.98)	-5.982*** (-3.38)
Poland	-12.302*** (-9.67)	-11.727*** (-7.79)	-13.089*** (-6.57)
Denmark	3.248** (2.30)	2.761* (1.94)	-0.342 (-0.18)
Average risk	-5.117*** (-5.60)	-4.502*** (-4.49)	-3.227** (-2.53)
No risk	-11.624*** (-12.12)	-10.414*** (-9.90)	-10.806*** (-8.06)
Constant	29.267*** (9.92)	27.034*** (4.32)	30.226*** (9.49)
Observations	1,287	920	609
F-statistic first stage	34.16	27.75	16.57

Note: Robust z-statistics in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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