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Participation in supplementary pension savings in Iceland*

Ásgeir Daníelsson[†], Rannveig Sigurðardóttir[‡], and Svava J. Haraldsdóttir[†]

Abstract

We analyse participation in supplementary pension savings in Iceland using microdata on every person, aged 16 and over, registered in Iceland in 1999-2017. Although sizeable subsidies are offered, a large share of those eligible do not participate. The significant increase in subsidies in 2014 did affect participation, although less than expected. We find that women participate significantly more than men, apart from the youngest and oldest age groups. The difference between women and men is larger for single persons than for couples. It is also larger for those with only primary education than for those with tertiary education. The subsidies are such that the rate of return on the savings increases with age. Despite this, we find that participation rates are nearly constant between age 30 and age 60, whereupon participation starts to decline at around the time the savings can be withdrawn. We observe a significant correlation between the decision to start withdrawing funds and the decision to stop participating. Estimating equations for wage income using cross-sectional data, we find the usual concave (Mincer) shape, except for people in their late sixties, whose average wage income starts to increase, reflecting the tendency among higher-income people to retire later. We discuss the problems caused by the correlation between income and education, and between income and gender, and we use two-stage probit least squares to test for exogeneity of income.

Keywords: Supplementary pension saving, Incentives for saving, Rationality

JEL Classification: H2, H3, D12, D140

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1 Introduction

Iceland first passed legislation on supplementary pension savings in 1997. The goal was to increase savings and create voluntary, privately owned savings in addition to the mandatory pension system where most savings are mutual pension savings.¹ Today, more than half of those eligible choose to contribute to the supplementary pension scheme, in addition to mandatory pension savings amounting in most cases to at least 15.5% of the worker's wage.

From the beginning, there were built-in incentives to encourage participation in supplementary pension savings. Like other pension savings in Iceland, they are exempted from tax on capital income. Payments into pension savings schemes are not taxed, but withdrawals are taxed as wage income. The employer's matching contribution makes the return on the employee's contribution to supplementary pension savings very high and increasing with age. With the option introduced in 2014 of allocating supplementary pension contributions tax-free towards mortgage loan principal, the total incentive provided by the employer and the state can amount to 3.85% of the worker's gross wage, tax-free.

Even though the rate of return on wage-earners' contribution to supplementary pension savings is high, not all of those eligible participate. The participation rate among Icelandic wage-earners aged 25-69 and working full-time was 77% in 2017 (the last year in our dataset). The participation rate for all wage-earners was 61.7%, as participation among Icelanders working part-time and among foreigners is much lower than among Icelanders working full-time. Participation among the self-employed is lower still, as the matching contribution is not an incentive for them. In this paper, we focus on Icelandic wage-earners working full-time, as they represent the largest and the most homogeneous group.

Because the annual rate of return on an employee's contribution increases with age, we would expect to see participation rise with age, but we find the opposite. Among Icelandic wage-earners working full-time, participation is stable for most years in our sample, with the exception of those under age 30 and over age 60. Supplementary pension savings (Pillar III according to the World Bank classification) are available for withdrawal when participants reach age 60, five to seven years before they become eligible for pension income from their mandatory pension funds (Pillar II) and the Social Insurance Administration (Tryggingastofnun) (Pillar I). As it takes only few weeks to process a request for withdrawals, those still working after age 60 and paying into supplementary pension savings can withdraw their own and their employers' contributions almost immediately. Therefore, traditional economic explanations for non-participation, a high subjective discount rate, and/or liquidity problems can hardly explain why those over 60 do not participate in this attractive savings option, which gives at least 2% of their wage at negligible cost. It is even more surprising that not only is there no increase in

¹ We use the term *mutual savings* for what is called "sameignarsjóðir" in Icelandic. These funds pay retirees a price-indexed lifetime annuity proportional to payments received. More information about the basic pension system in Iceland can be found in Central Bank of Iceland (2022), pp.21-22.

It is common in Iceland to confuse supplementary pension savings (*viðbótarlífeyrissparnaður* in Icelandic) and private pension savings (*séreignarlífeyrissparnaður*). All supplementary pension savings are paid into a private savings account, but since Act no. 141/1997 entered into force, some employees have had part of their mandatory pension contribution paid into private pension savings accounts as well. In this paper, we focus solely on optional supplementary pension savings.

participation around age 60, participation in supplementary pension savings among people over 60 actually declines.

Economic research has shown that people do not always behave as if they base their decisions on rational calculations of economic benefits and costs. Habit and potentially inaccurate perceptions may also play a role. People are less likely to choose an option that involves action on their part, even if it requires minimal effort while yielding substantial gains (see, for instance, Chetty et al., 2014, and Madrian and Shea, 2001). Choosing the default option can therefore have a significant impact. Madrian and Shea (2001) studied pension savings (401(k)) in a large US company. The company's pension system was in many ways similar to the supplementary pension system in Iceland. The main incentive for participation was a 50% matching contribution from the employer, and those wishing to participate had to apply.

To boost participation, the firm decided to change the default option and register all employees as participants, while allowing those who did not want to participate to opt out. Madrian and Shea (2001) found that this change from opt-in to opt-out increased participation from 57% to 86%. Given these results, it seems reasonable to expect that participation in supplementary pension savings in Iceland would increase substantially if participation were made the default option.

Madrian and Shea (2001) also found that employees chose the default share of the wage significantly more often than might have been expected based on their choices before the change took place. They suggested that this was because employees interpreted the default share announced by the company as advice, not merely as an arbitrary suggestion.

In our search for the reasons why participation in supplementary pension savings declines after age 60, we found that those who start withdrawing their supplementary pension savings while still working are more likely to stop participating in supplementary pension savings than those who do not start withdrawing while continuing to work. It may be that some individuals think it is somehow "natural" to stop making supplementary pension contributions when they start withdrawals.

Financial literacy matters for financial decisions (see, for instance, Lusardi and Mitchell, 2014). We do not have direct measures of financial literacy in our dataset, but educational levels are correlated with participation when we do not control for income; however, as educational levels are correlated with income, the positive correlation disappears when income is included.

Many researchers (see, for instance, Huberman et al., 2007, Lusardi and Mitchell, 2014, Konsumentverket, 2018, and Bucher-Koenen et al., 2021) have observed differences between financial literacy and financial decision making by men and women. We find that women participate significantly more in supplementary pension savings than men do, and that the difference is greater for single persons than for those living with a partner.

Our research exploits a rich administrative panel dataset of annual tax records from all Icelandic taxpayers from 1999 to 2017. The data are collected by Statistics Iceland and Iceland Revenue and Customs. The dataset also includes information on education, the industry in which the

individual is employed, the number of weeks worked in a year, the individual's age, partner if not single, and the number and age of children in the individual's household.

The rest of the paper is organised as follows. Section 2 gives a detailed description of the laws and regulations on supplementary pension savings in Iceland from 1997 onwards. Those not interested in the details of the regulatory framework and its evolution may skip to Section 3.

Section 3 describes participation in supplementary pension savings among wage-earners from 1999 through 2017. Section 3.1 describes developments over time in participation in supplementary pension savings, particularly changes in participation in 2008-2010 and 2013-2014. Section 3.2 describes participation by selected subgroups, including an analysis of participation among Icelandic men and women working full-time and participation broken down by education and wage income.

Section 4 discusses possible explanations for the counterintuitive finding that participation in supplementary pension savings declines after age 60. Section 4.1 analyses whether those who still work full-time and start to withdraw their supplementary pension savings are more likely to stop participating at the same time. Section 4.2 discusses various ways that aggregation may influence estimates of participation rates in cross-sectional data. Section 5 describes the results of the regression analysis. Section 6 adds to the discussion (in Section 3.1) concerning the option to allocate supplementary pension contributions tax-free towards mortgage loan principal. Section 7 concludes.

2 A brief history of supplementary pension savings in Iceland

The framework for optional supplementary pension savings in Iceland can be found in Act no. 129/1997. Concurrent with the passage of that Act in Parliament, Iceland's income tax laws were amended, increasing the maximum share of wage income that could be paid tax-free into pension funds from 4% to 6%.² The aims of this new legislation were: 1) to increase saving;³ 2) to allow pension funds that previously only offered mandatory and mutual pension schemes to offer optional pension savings in private accounts as well. The law also mandated that the few pension funds that until then had only offered private pension savings should also offer mutual pension savings;⁴ and 3) to allow those who had some private pension savings to select a financial institution to act as custodian for these savings. This option enabled not only pension funds but also commercial banks, savings banks, life insurance companies, and securities firms to apply to become custodians of private pensions.

Even though the incentive for participating in the supplementary pension savings scheme was much smaller in the beginning than it is now, there were several advantages compared to voluntary savings. First, marginal taxes on wage income are normally lower when the pension is paid out than they are when the individual pays into the pension scheme. Second, the capital

² Act no. 141/1997. In 2000 the ceiling was increased from 6% to 8%. The minimum employee contribution of 4% remained unchanged.

³ See the speech given in Parliament by the Minister of Finance, Friðrik Sófússon: <https://www.althingi.is/altext/122/11/r18133412.sgmI>.

⁴ See Paragraph 4 and 13-19 (Chapter III) of Act no. 129/1997. See also the overview of the history of Frjálsi Pension Fund on its website: <http://www.frijalsi.is/fleira/um-frjalsa/>.

income on supplementary pension savings is tax-free, whereas there is currently a 22% tax on nominal income from private assets. Third, neither the asset value of the private pension savings nor the capital income from these savings affects entitlements such as child benefits or mortgage interest subsidies. Offsetting these incentives is a long waiting period, especially for young people, as in most cases withdrawals are not permitted until age 60. This may be why very few people opted into the supplementary pension scheme during the first year, which led to the addition of more incentives. First, Act no. 148/1998 stipulated that the employer should also pay into the supplementary pension scheme for those employees who chose to participate. This additional contribution should be 10% of the employee contribution, which meant that a person who decided to contribute 2% of their wage to supplementary pension savings received an additional 0.2% from their employer. As employers could reduce their payroll tax by the same amount, this additional contribution was eventually financed by the Government. Act no. 48/1998 entered into force on 1 January 1999.

Early in 2000, confederations of employees and employers agreed to include a special employer contribution to supplementary pension savings. From mid-2000 onwards, this contribution was to be half of the employee contribution for contributions up to 1% of the wage, and from 1 July 2002 onwards it should increase to the full amount of the employee contribution up to 2% of the wage. By the end of 2001, a new wage contract stipulated that from 1 July 2002 onwards, employers should pay 1% of the wage into the employee's private pension savings account, independent of their contribution to supplementary pension savings. This meant that those who paid 2% of their wage into supplementary pension savings received 1% from the employer for participating, instead of the previous 2%.

From 1 January 2005 onwards, the employer contribution to the supplementary pension savings scheme was to equal the employee's contribution, up to a contribution of 2% of the wage. The 1% contribution for all into private pension savings was terminated at that time, but instead the employer contribution to the mutual pension savings scheme was increased from 6% to 7%, and on 1 January 2007 it was increased to 8%.

Payments into both voluntary supplementary pensions and mandatory pensions are exempted from taxes, as is the capital income earned on these savings, but benefits paid from pension savings are taxed as wage income. Payments from supplementary pension savings are excluded from calculations of social security payments, unlike payments from mandatory pension savings. Furthermore, supplementary pension savings are the only type of asset that is exempted from inheritance tax in Iceland.⁵

A person who owns some supplementary pension savings can start withdrawing them at age 60.⁶ In the aftermath of the 2008 financial crisis, Parliament passed legislation granting people under age 60 access to their private pension savings. Each time such access was granted by law, it was temporary and subject to a maximum amount.

⁵ See Article 1, Paragraph 4 of Act no. 129/2004: www.althingi.is/lagas/nuna/2004014.html.

⁶ In case of accident or illness that reduces the person's ability to work, supplementary pension savings may be withdrawn before age 60.

On 1 January 2004, the provision allowing employers that paid a matching contribution to their employees' supplementary pension savings to reduce their payroll tax by the same amount was repealed.

New legislation passed in 2014 made supplementary pension savings still more attractive by allowing up to 6% of wages paid into supplementary pension savings to be allocated tax-free towards the reduction of mortgage principal. Those who did not own a home and therefore had no mortgage debt could make tax-free deposits into dedicated housing savings accounts, which were earmarked for a future home purchase. Both types of payments were capped at 750,000 Icelandic krónur (5,000 euros) for couples and 500,000 krónur (3,333 euros) for single persons. This provision was originally set to expire on 30 June 2017 but has been extended several times, most recently through 31 December 2024.⁷

Act no. 111/2016, which provided support for an individual or couple's first home purchase, entered into force on 1 July 2017.⁸ This law allows payments from supplementary pension savings to be allocated tax-free to the person's first home purchase, subject to certain conditions. The Act does not contain a sunset clause.

Table 1 shows developments in the cap on employees' tax-free payments into supplementary pension savings and developments in both employer and Government contributions.

In the wake of the financial crisis, the law was amended to allow people under age 60 to withdraw funds from their private pension savings. The first time this was authorised, withdrawals had to be made between 1 March 2009 and 1 October 2010, and were subject to a ceiling of 1 million Icelandic krónur per person.⁹ This provision was extended several times. When the last period ended, at the end of 2014, the ceiling on withdrawals was 9 million krónur (60,000 euros). In 2020 and 2021, in response to COVID-19 pandemic, people under age 60 were once again allowed to withdraw funds from their private pension savings, up to a ceiling of 12 million krónur (80,000 euros).

In January 2016, the Icelandic Federation of Labour (ASÍ) and the Confederation of Icelandic Employers (SA) agreed to increase the employer contribution to mandatory pension savings by 3.5 percentage points, in increments, between 1 July 2016 and 1 July 2018. This increase is paid into mutual pension savings unless the employee requests that it be paid into a private savings account.

⁷ Act no. 51/2023, <https://www.althingi.is/altext/stjt/2023.051.html>.

⁸ See Act no. 111/2016: www.althingi.is/lagas/146a/2016111.html.

⁹ The bill of legislation, Parliamentary Document no. 553, Case no. 321, can be found at <http://www.althingi.is/altext/136/s/0553.html>. 1,000 Icelandic krónur equals 6.667 euros.

Table 1: History of supplementary pension savings

	Employee's tax-free contribution	Employer contribution	Government contribution
1 January 1999	Up to 2%	0%	Employer is allowed to reduce payroll tax against contribution to supplementary pension savings. This contribution could be 10% of the employee's contribution, capped at 0.2% of the employee's wage .
2000	Up to 4%	Half of the employee contribution, subject to a ceiling of 1% the employee's wage.	The ceiling was increased to 0.4%.
2002		100% match of employee's contribution, up to 2% of the employee's wage.	
1 July 2002		Employers should contribute 1% of the wage of all employees, which effectively means that wage-earners who pay into supplementary pension savings receive an additional contribution amounting to half of their own contribution, up to 2% of the wage.	
1 January 2004			The allowance to reduce the payroll tax is repealed.
1 January 2005		The 1% contribution for all employees is transferred into the public compulsory pension system, where the employer's contribution is increased from 6% to 7%. The contribution to those who participate in the supplementary pension savings scheme increases back to a matching contribution of 100% of the employee's contribution, up to 2% of the wage.	
1 March 2009	Up to 6%		
1 October 2010	Up to 4%		
1 January 2012	Up to 2%		
1 July 2014	Up to 4%		Tax-free allocation of new supplementary pension savings contributions to mortgage loan principal or dedicated housing savings accounts.

Source: Authors' summary.

The employer's obligation to pay into an employee's pension fund ends when the employee reaches age 70. This applies both to payments into mandatory pension saving schemes and the optional supplementary pension savings accounts. The employee may continue to contribute to these pension schemes after age 70, and some do. For those who continue to earn wages after age 70, the incentive to pay into supplementary pension savings is much smaller without the matching employer contribution, but both the option of using supplementary pension savings to make tax-free payments towards mortgage loan principal and the possibility that tax rates will be lower when the funds are withdrawn should still be strong incentives. Nevertheless, participation rates drop rapidly after age 69.

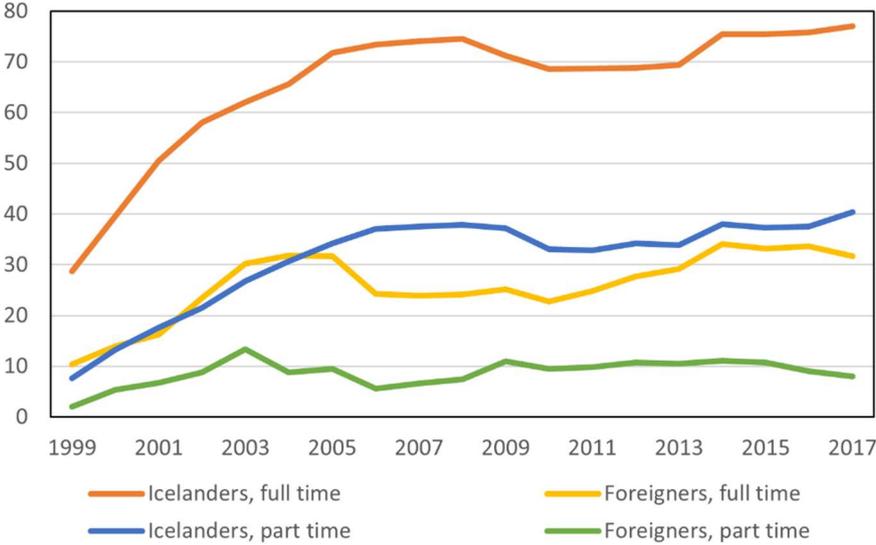
3 Developments in participation in supplementary pension savings

3.1 Developments in participation over time

Participation in supplementary pension savings was limited at the beginning (see Figure 1). In 1999, participation rates were as follows: 28.7% of Icelandic wage-earners aged 25-69 and working full-time, 7.6% of Icelanders working part-time, 10.4% of foreign wage-earners

working full-time, and 2% of foreigners working part-time.¹⁰ Over the next few years, participation among Icelanders increased sharply, reaching a plateau in 2005. Then, in the wake of the financial crisis (2008 -2010), participation rates fell for both full-time and part-time wage-earners (by 5.9 and 4.8 percentage points, respectively).

Figure 1. Participation rates in supplementary pension schemes 1999-2017



Note: Participation rates (in %) among wage-earners 25-69 years old.

Sources: Statistics Iceland, Central Bank of Iceland.

After remaining relatively stable for a few years, participation rates among Icelanders increased again in 2014, returning to the pre-crisis level. That same year, Parliament passed a new law authorising new supplementary pension contributions to be allocated tax-free towards the reduction of mortgage loan principal. Participation among Icelanders aged 25-69 and working full-time increased that year by 6.1 percentage points (4.1 percentage points for part-time wage-earners).¹¹ Participation remained quite steady over the next two years, but in 2017, the last year included in our study, participation among Icelandic wage-earners increased slightly. Although the level of participation of Icelandic wage-earners working part time differs from that of Icelandic wage-earners working full time, the evolution of participation rates of the two groups are similar.

The share of foreign wage-earners in Iceland increased substantially during the period included in the study. In 1999, 2.2% of all full-time wage-earners and 6.5% of part-time wage-earners were foreign nationals, as compared with 10.9% and 26.6%, respectively, in 2017. Supplementary pension savings participation among foreign wage-earners was much lower than among Icelanders throughout the period, and the share of foreign wage-earners

¹⁰ We define those employed less than 10 months in a given year and those with annual income below some specific number which varies over time as part-time wage-earners. The latter specification filters out young people still in school but working part-time, which is common in Iceland. This definition affects the number of foreign part-time wage-earners, who often work full-time for short periods in Iceland.

¹¹ Participation increased by 4.9 percentage points among foreign nationals working full-time and by 0.5 percentage points among foreign nationals working part-time.

participating progressed somewhat differently from that of Icelanders. The decline in foreign wage-earners' participation after 2005 and again after 2015 is probably due to the large influx of foreign wage-earners during these two periods of pronounced excess demand for labour in Iceland.¹² Newcomers are less likely to participate, as they are less likely to know about their rights. They may also distrust that their rights will be respected by institutions in a foreign country.

3.1.1 The decline in participation in the wake of the financial crisis

During the aftermath of the financial crisis, between 2008 and 2010, most wage-earners continued to participate in supplementary pension savings, as the matching employer contribution continued to make participation a desirable saving opportunity. However, a significant number stopped participating. High subjective discount rates and/or a liquidity squeeze in the midst of a deep financial crisis, leading to the forced sale of important assets, can make stopping participation in a saving scheme with high returns a rational decision. This would apply in particular to young people, for whom the average annual return on supplementary pension contributions is lower. Indeed, our findings show that the decline in participation is greatest among young people. We find only small differences between the decline in participation among those who own a home and carry mortgage debt and those who do not.

Table 2. Changes in participation rates 2008-2010

Income group	1	2	3	4	5	Total
Primary education	-6.4	-6.9	-7.0	-3.6	-4.7	-5.9
Secondary education	-6.6	-7.3	-6.5	-4.8	-2.9	-6.0
Tertiary education	-7.7	-7.1	-6.1	-5.2	-4.9	-6.5
Own flat	-7.1	-7.2	-6.5	-4.8	-4.1	-5.7
Do not own flat	-7.0	-7.2	-6.3	-4.4	-4.8	-6.1
Housing debt	-6.6	-7.5	-7.3	-4.9	-4.4	-6.0
No housing debt	-7.4	-6.1	-4.2	-3.9	-3.7	-5.4
Men	-5.9	-6.4	-6.9	-5.0	-3.8	-5.6
Women	-6.9	-7.6	-6.5	-4.7	-6.2	-6.4
Total	-7.0	-7.1	-6.4	-4.7	-4.3	-5.9

Note: Income group 1 contains the 20% with the lowest wage income, income group 2 contains the 20% above group 1, and so on, with income group 5 containing the 20% with the highest wage income. Changes in participation rates are calculated for Icelandic wage-earners aged 25-69 and working full-time and are expressed in percentage points.

Sources: Statistics Iceland, Central Bank of Iceland.

Changes in participation rates between 2008 and 2010 for Icelanders aged 25-69 and working full-time are shown in Table 2.¹³ Participation rates declined for all groups in the table. In all, the participation rate for women declined more than that for men. The participation rate for

¹² The share of foreign wage-earners in the labour force increased from 4.9% in 2005 to 9.0% in 2008, and from 8.8% to 12.0% between 2015 and 2017.

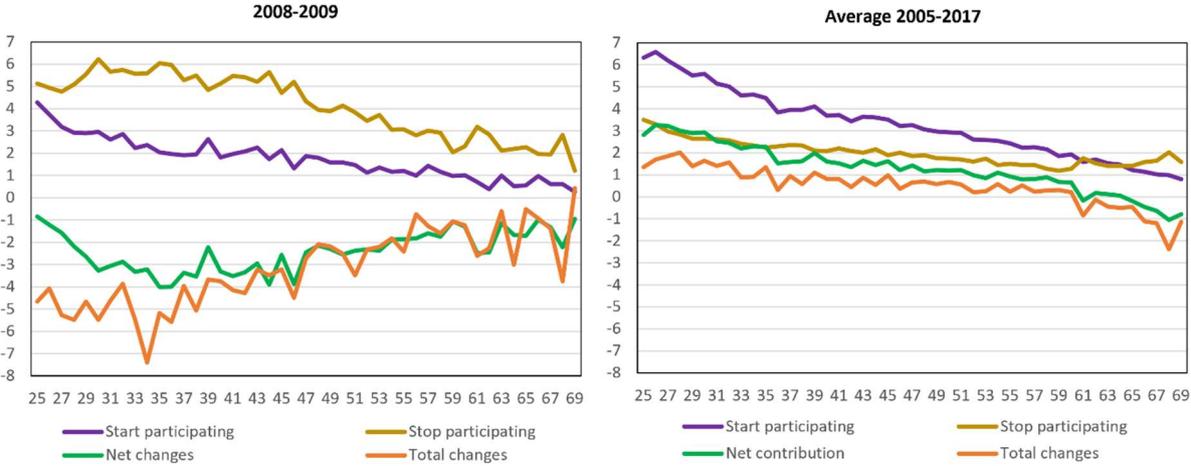
¹³ To limit the scope of the analysis presented in this paper, we focus mainly on Icelanders working full-time, as they constitute by far the largest and the most homogeneous subset.

tertiary-educated declined more than that for other educational groups, and from a higher level. Participation among those not carrying mortgage debt decreased the least.

There is some variation in the change in participation rates across the various income groups, but the overriding trend is that participation decreases more as income is lower. The decrease in participation for the lowest-income group measured 7.0 percentage points, as compared with 4.3 percentage points for the highest-income group.

Figure 2 illustrates the contribution to participation rates by those who participate in a given year and then stop the following year, as well as the contribution by those who do not participate in a given year and then begin the following year. The left-hand panel in Figure 2 shows total changes in participation, by age, for Icelanders working full-time in 2008 and 2009 (orange line). We see that the decline in participation between 2008 and 2009 was greatest among young people but diminished gradually with age. We also see the contribution to the total change in participation rates by those who worked full-time in both years and: 1) participated in 2009 but not in 2008 (purple line); 2) participated in 2008 but not in 2009;¹⁴ and 3) the net of these two (green line). For the most part, the contribution of those who stopped participating in 2009 and those who started participating in 2009 declined with age.

Figure 2. Contribution to changes in participation rates



Note: The left-hand panel shows contributions to changes in participation rates (in percentage points) for 2008-2009. The x-axis represents the age of participants in 2009. The right-hand panel shows average contributions to changes in participation rates (in percentage points) for 2005-2017. The x-axis shows the age of participants in the latter year. A more detailed description of these calculations can be found in the Appendix.

Sources: Statistics Iceland, Central Bank of Iceland.

The right-hand panel in Figure 2 shows the averages of the contributions to changes in participation rates for 2005-2017.¹⁵ Comparing the right- and left-hand panels of Figure 2

¹⁴Total changes are also affected by those who did not work full-time during the former year but did so in the latter year, and by those who worked full-time in the former year but not in the latter year. A more detailed description of these calculations can be found in the Appendix.

¹⁵ We calculate the averages of changes in participation between 2005 and 2006, 2006 and 2007, and so on, until the twelfth and last changes between 2016 and 2017, the last two years in our dataset. We start in 2005 because participation rates had reached some stability by then, after increasing rapidly from a very low level at the start of supplementary pension savings in 1999 (see Figure 1).

shows that more people stopped participating in 2009 than in the average year, and fewer started.¹⁶ Because the slope of the line showing the contribution by those who stopped participating in 2009 is steeper than that of the line showing the contribution by those who started participating, the line showing the net contributions of the two is upward-sloping. For most other years, the lines showing net contributions by those who start participating and those who stop, while working full-time in both years, are close to the lines exhibiting the total change in participation rates. On the other hand, the line showing the net contributions to changes in participation rates between 2008 and 2009 are exceptionally close to the line showing the total change in participation rates, except for the youngest age groups. This shows that in these years, the aggregate effect of other factors influencing participation rates was close to zero for most age groups.¹⁷

3.1.2 Increased participation in 2014

Participation in supplementary pension savings increased significantly in 2014. The most obvious reason for this is the launch of the authorisation to use contributions to supplementary pension savings, free of income tax, to pay down mortgage loan principal.¹⁸ Table 3 shows changes (increases) in participation between 2013 and 2014 for various groups of Icelandic wage-earners aged 25-69 and working full-time. Participation among the tertiary-educated increased the most, and, as expected, participation among those carrying mortgage debt increased more than among those without a mortgage (7.3 and 3.5 percentage points, respectively).

The increase in participation among those without mortgage debt indicates that the new option should not be given credit for the entire jump in participation in 2014. The fact that participation among those without mortgage debt also rose, even though they could not benefit from the tax-free option, probably stems in part from advertisements by the Government and supplementary pension custodians, casting the new benefits in a favourable light, and media coverage of the new measures at that time.¹⁹ However, the increase probably reflects the added possibility that some of those who started to participate in 2014 may have done so to take advantage of the newly introduced option of paying tax-free into a dedicated housing savings account that they could use later to buy a home (for further discussion, see Section 6).

¹⁶ The line for those who started participating in 2009 lies lower and is less steep, on average, than that for 2005-2017.

¹⁷ Note that total changes also include changes in participation among those who worked full-time but stopped working full-time in 2009, as well as those who did not work fulltime in 2008 but did so in 2009.

¹⁸ These allocations to mortgage principal were capped at 750,000 krónur (5,000 euros) per year for couples and 500,000 krónur (3,333 euros) for single persons. For those who pay the highest marginal tax rate of 46.25%, the benefit of allocating 750,000 krónur to mortgage principal tax-free is 346,875 krónur (2,313 euros).

¹⁹ The launch of the new options for those participating in supplementary pension savings coincided with the launch of another measure unrelated to supplementary pension savings, *the Correction* (*Leiðréttingin* in Icelandic), a Government-funded programme to reduce certain households' mortgage debt.

Table 3. Changes in participation rates 2013-2014

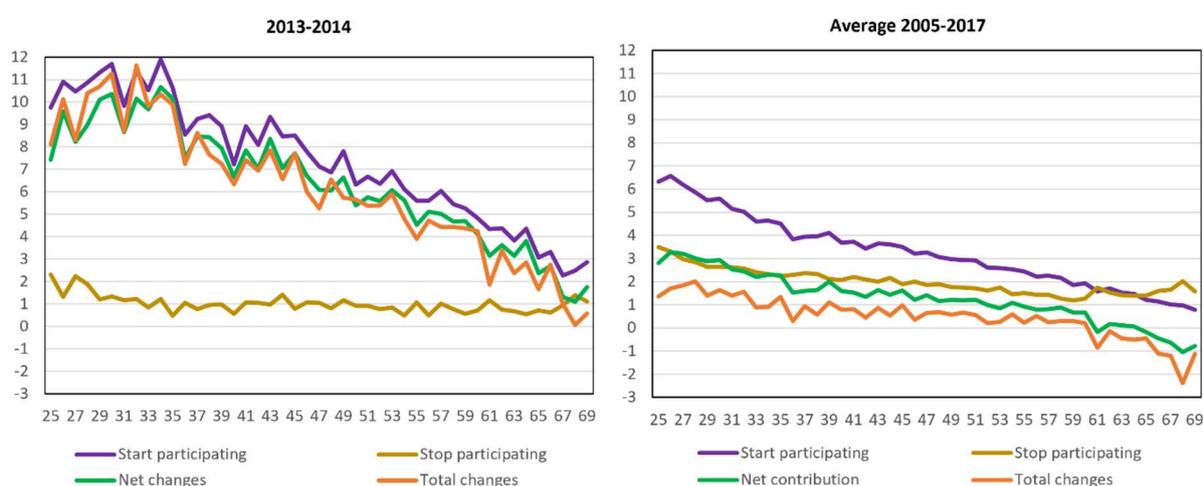
Income group	1	2	3	4	5	Total
Primary education	3.4	4.2	4.6	3.8	4.9	4.2
Secondary education	3.2	6.3	6.2	5.8	5.2	5.3
Tertiary education	6.6	6.7	8.8	9.0	6.9	7.7
Own flat	4.8	6.2	7.0	7.4	6.0	6.6
Do not own flat	3.4	5.3	6.6	6.2	6.4	5.6
Housing debt	5.7	7.1	7.7	7.5	6.9	7.3
No housing debt	1.7	3.7	4.9	5.0	3.1	3.5
Men	2.8	6.0	7.2	7.1	6.1	6.2
Women	4.7	5.6	6.5	6.4	6.5	6.1
Total	3.9	5.7	6.8	6.9	6.2	6.1

Note: Income group 1 contains the 20% with the lowest wage income, income group 2 contains the 20% above group 1, and so on, with income group 5 containing the 20% with the highest wage income. Changes in participation rates are calculated for Icelandic wage-earners aged 25-69 and working full-time and are expressed in percentage points.

Sources: Statistics Iceland, Central Bank of Iceland.

While changes in participation in the immediate aftermath of the financial crisis show clear differences across various income groups, the increase between 2013 and 2014 shows no clear trend by income, except that changes in participation are least pronounced among those with the lowest income.

Figure 3. Contributions to changes in participation rates



Note: The left-hand panel shows contributions to changes in participation rates (in percentage points) in 2013-2014. The x-axis represents the age of participants in 2014. The right-hand panel shows average contributions to changes in participation rates (in percentage points) in 2005-2017, which means that it contains the same lines as in the right-hand panel of Figure 2. The x-axis shows the age of participants in the latter year. A more detailed description of these calculations can be found in the Appendix.

Sources: Statistics Iceland, Central Bank of Iceland.

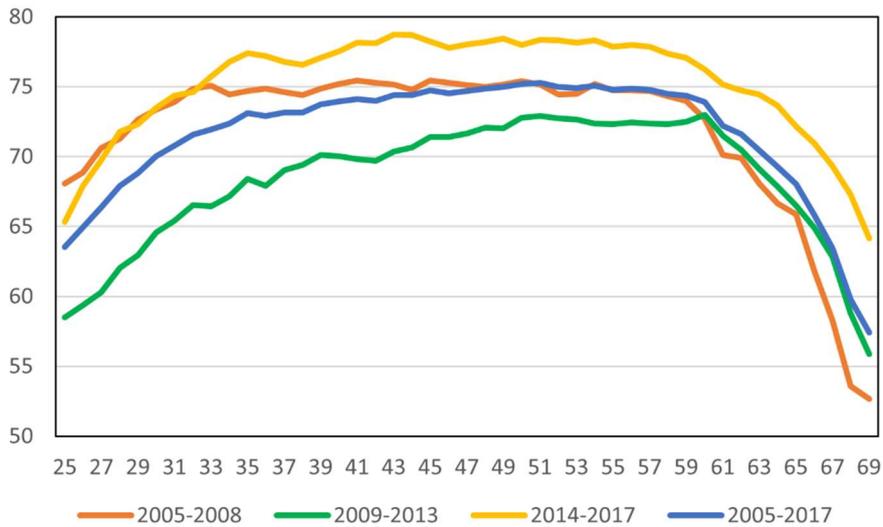
Figure 3 shows the change in participation, by age, in 2014 (left-hand panel), and the average for the period 2005-2017 (right-hand panel). We see that the purple line showing the contribution by those who start participating in the left-hand panel lies much higher than the equivalent line for the average of the twelve contributions in the right-hand panel, indicating

that more people started participating in 2014 than in an average year. Furthermore, the increase in participation in 2014 was more closely related to age than in the average year.

3.1.3 The slope of participation by age becomes flat again

Figure 4 shows average participation rates, by age, for Icelanders working full-time, for 2005-2017 and three sub-periods: 2005-2008, 2009-2013, and 2014-2017. We can see that prior to the financial crisis, in 2005-2008, and again after 2014, participation rates remained fairly flat among wage-earners in their early thirties to late fifties. During the period immediately following the financial crisis, 2009-2013, participation rates were lower and increased with age in this age range. As is noted above, this is because net negative changes in participation in the wake of the financial crisis were larger for the younger age groups. This was "corrected" in 2014, as the net changes in participation at that time were positive and larger for younger age groups than for older groups.

Figure 4. Average participation rates among Icelandic wage-earners working full-time, by age



Note: Average participation rates (in %) over different periods. Participation rates are calculated for Icelanders working full-time. The x-axis shows the age of participants.

Sources: Statistics Iceland, Central Bank of Iceland.

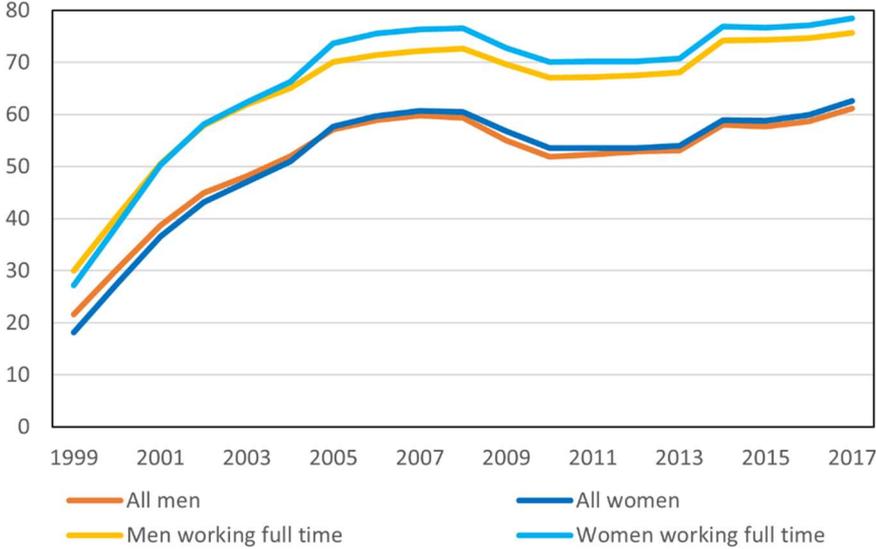
3.2 Participation in supplementary pension savings, by subgroup

3.2.1 Participation by gender and age

In the aggregate, the difference between male and female Icelanders' participation in supplementary pension savings is small. Furthermore, their participation has developed similarly over time; e.g., the decline in 2008-2010 and the increase in 2013-2014 were almost identical (Figure 5). In 1999, male wage-earners' participation rate was 3.4 percentage points higher than that of female wage-earners. The difference diminished gradually thereafter, and

by 2005, women’s participation exceeded that of men by 0.5 percentage points. It has done so since then, by a maximum of 2 percentage points.

Figure 5. Participation rates, by gender



Note: Participation rates (in %), by gender, in 1999-2017, calculated for Icelandic wage-earners aged 25-69.

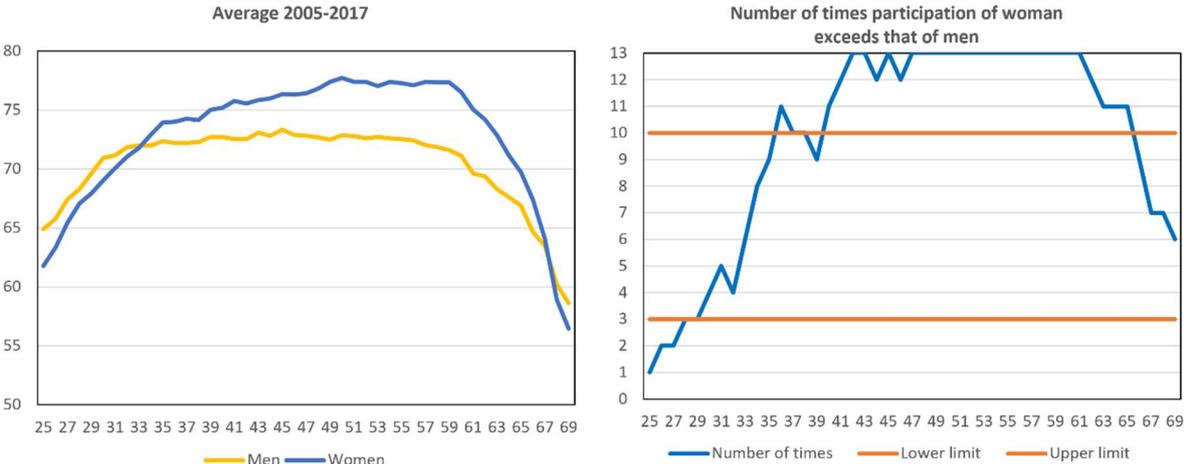
Sources: Statistics Iceland, Central Bank of Iceland.

The left-hand panel in Figure 6 shows the average participation rate for the thirteen-year period 2005-2017. We see that men had higher average participation rates than women until they reached their early thirties. After that, women’s participation exceeded that of men until age 68, when men’s participation overtook that of women. On average, women’s participation rate was 3 percentage points higher than men’s, with the largest difference at age 59, when it measured 5.7 percentage points.

The right-hand panel in Figure 6 shows, for each age, the number of years women’s participation exceeded that of men. This number can be used to test whether the difference between the rates for women and men of a given age is statistically significant. If the rates are equal, the probability that participation among women exceeds that of men in one year is 0.5, and we would expect to observe that women’s participation exceeds that of men roughly half of the time. To observe that women’s participation exceeds that of men all thirteen times would be very unlikely if the true rates were equal. Furthermore, if that happened, it would be possible to reject the hypothesis that the ratios are in fact equal in favour of the hypothesis that participation among women of a given age is significantly greater than among men of the same age. We assume that the participation rates for men and women in each year are independent and that the probability of women’s participation exceeding that of men is 0.5. Given these assumptions (the null hypothesis), the number of times women’s participation exceeds that of men is binomially distributed. If the number of trials is thirteen, the probability of ten or more years where women’s participation exceeds that of men is 0.046, and the probability of eleven or more years is 0.011. The probability that women’s participation will

exceed men’s three times or fewer is 0.046, and the probability of two or fewer such cases is 0.011. Using this, we see that men’s participation was significantly greater than women’s at the 5% significance level for the youngest age groups (25-27), and the participation of women was significantly greater than that of men from around age 40 and until participants reached their mid-sixties.

Figure 6. Participation rates, by age and gender



Note: The left-hand panel shows average participation rates (in %) in 2005-2017, by age and gender, calculated for Icelanders working full-time. The right-hand panel shows the number of years women’s participation rate is higher than that of men during the period 2005-2017. In both panels, the x-axis shows the age of participants.

Sources: Statistics Iceland, Central Bank of Iceland.

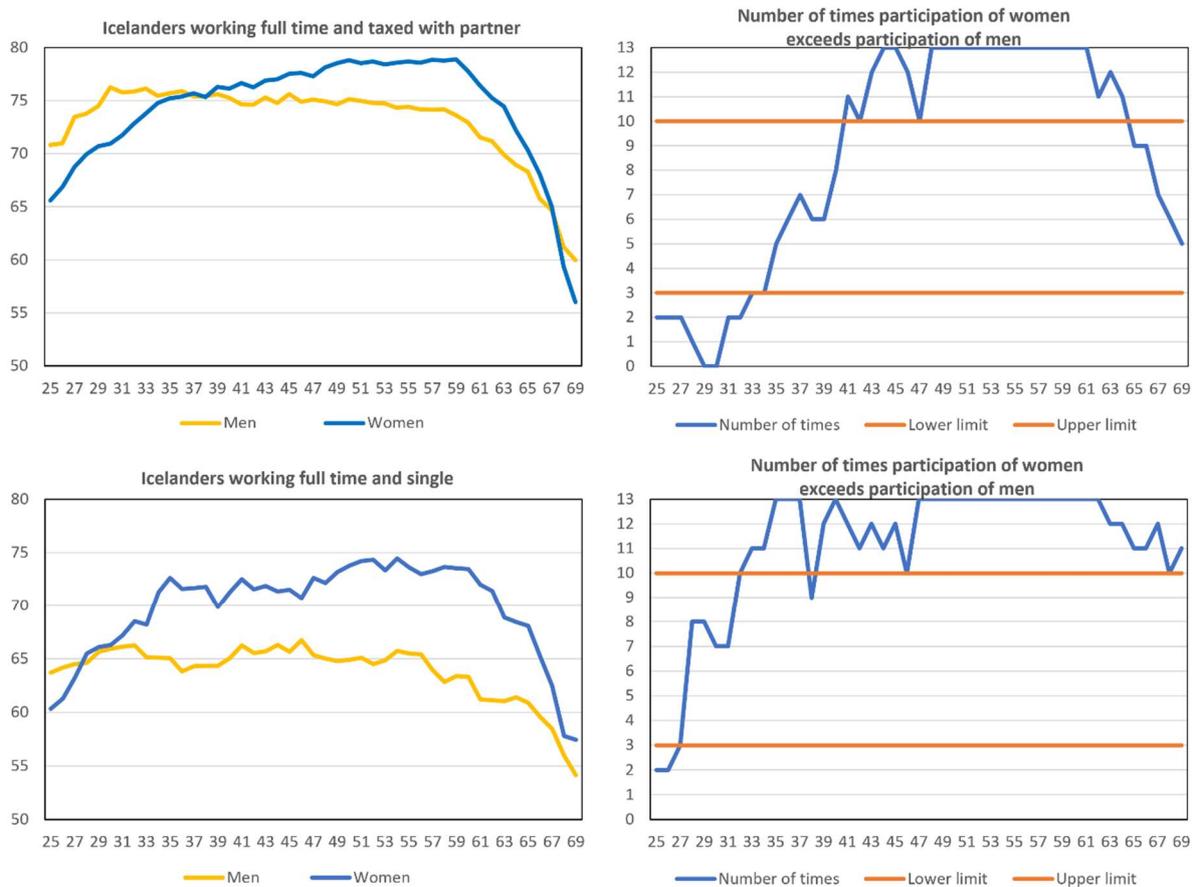
Figure 7 conveys the same information as Figure 6, but for people who are living with a partner and are jointly taxed (upper panel), and people who are single (lower panel).²⁰ The upper left-hand figure shows average rates of participation in supplementary pension savings, by age, for married or partnered (i.e., jointly taxed with a partner) Icelandic men and women who work full-time. For those living with a partner, men participated more, on average, than women of the same age until participants reached their mid-thirties, when participation rates became identical. After that, women’s participation was higher than men’s, up to age 68, when men’s participation overtook women’s again. The average difference between the participation rates of men and women aged 25-69 was 1.1 percentage points, with the largest difference, 5.3 percentage points, occurring at age 59.

In the lower part of Figure 7, we see the same information for single wage-earners. Developments in participation are broadly the same, although women’s participation overtakes men’s earlier than in the case of married wage-earners, and the differences are larger, on average.²¹

²⁰ We use the Iceland Revenue and Customs definition of jointly taxed couples, which includes married couples who do not apply for separate taxation and unmarried couples who meet the requirements for joint taxation. 92% of all Icelanders working full-time belong to one of these two groups.

²¹ The average difference between gender participation rates for single wage-earners was 5.9 percentage points. The largest difference, 10.8 percentage points, occurred at age 58.

Figure 7. Participation rates, by age and gender



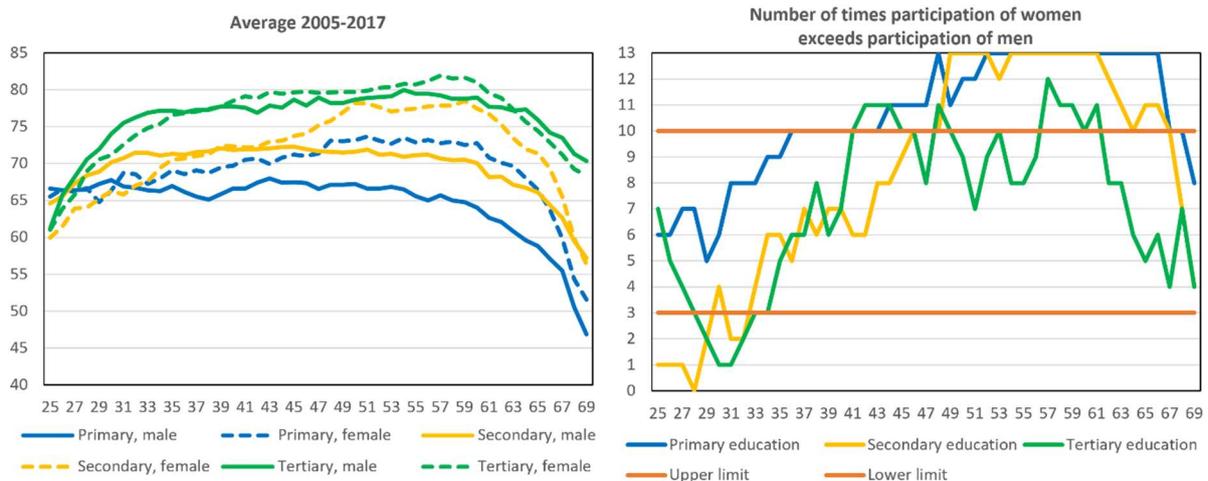
Note: The upper left-hand panel shows average participation rates (in %) in 2005-2017, by age and gender, calculated for Icelanders working full-time, living with a partner, and taxed jointly. The upper right-hand panel shows the number of years women's participation exceeded that of men during the period 2005-2017. The lower left-hand panel shows average participation rates (in %) in 2005-2017, by age and gender, calculated for single Icelanders working full-time. The lower right-hand panel shows the number of years women's participation exceeded that of men during the period 2005-2017. In all panels, the x-axis shows the age of participants.

Sources: Statistics Iceland, Central Bank of Iceland.

3.2.2 Participation by gender, age, education, and income

Participation among Icelandic men and women working full-time, by education and age, is shown in Figure 8. The left-hand panel shows average rates for the thirteen-year period and illustrates clearly that participation increases with education. The solid lines show participation among men, by education and age, and the broken lines show women's participation. For women at all levels of education and men with tertiary-level education, participation increases with age, while for men with primary and secondary education, participation begins to decline as early as age 40 – slowly at first, but then, as for the other groups, more rapidly after age 60.

Figure 8. Participation rates, by education and gender



Note: The left-hand panel shows average participation rates (in %) in 2005-2017, by education and age, calculated for Icelandic men and women working full-time as wage-earners. The solid lines show men's participation, by education, and the broken lines show women's participation, by education. The right-hand panel shows the number of times women's participation exceeded that of men. In both panels, the x-axis shows the age of participants.

Sources: Statistics Iceland, Central Bank of Iceland.

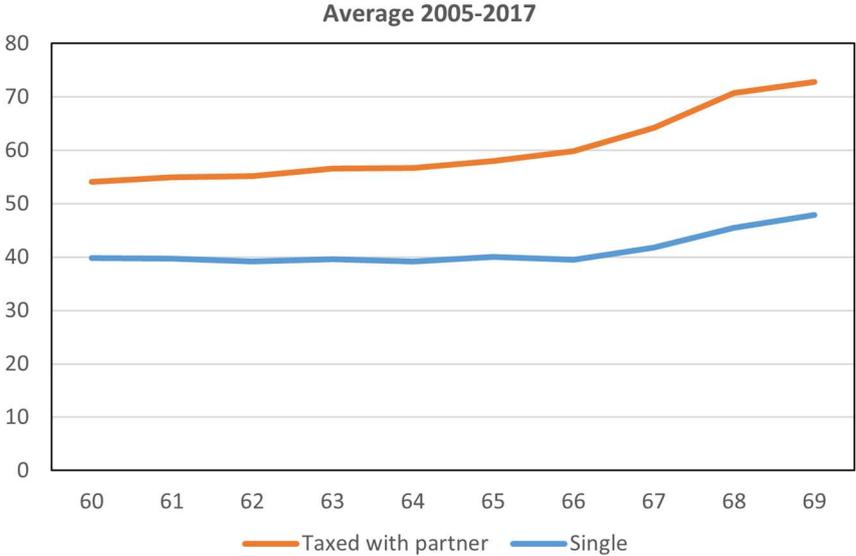
Figure 8 also shows that in most years, women's participation was higher than men's at all levels of education. The right-hand panel shows the number of times women's participation exceeded that of men's. It illustrates well that, from the time participants reached their early thirties, average participation among women with primary education exceeded that of men with the same education level. The difference was significantly larger for participants in their mid-thirties to late sixties. From the time participants reached their mid-forties, participation among women with primary education even exceeded that of men's with secondary education. Participation among women with secondary education was significantly higher than among men from around age 50 until participants reached their late sixties. The difference between women and men with tertiary education was smaller than for other educational groups and statistically insignificant in most cases. Moreover, women's participation was higher after age 60 for all educational groups except the tertiary-educated, where participation of men exceeded that of women after age 63.

One possible reason for women's greater participation in supplementary pension savings in Iceland is that their claims on pensions from the basic pension system are smaller. Huberman et al. (2007) studied participation in pension savings in the US and found that women were more likely to participate than men. They point out two possible explanations for this: first, women live longer; and second, women take decisions based on conditions in the household, including the income of their (usually higher-paid) husbands. Figure 7 above shows that participation among single women exceeded that among single men, and by a larger margin than among those with partners. This indicates that the latter explanation in Huberman et al. (2007) is not valid in the case of supplementary pension savings in Iceland.

The former explanation in Huberman et al. (2007) may apply to supplementary pension savings in Iceland. Men's retirement period is shorter than women's because they die earlier, on

average, and are older when they retire.²² One obvious reason for this is that women are frequently younger than their male partners, which means that if both partners decide to retire at the same time, the women will be younger at retirement. Comparing actual labour market participation, by gender, for single and married people, respectively, shows that single women also retire earlier than single men. The data in Figure 9 indicate that even if the effect of couples' retiring at the same time is a probable contributing factor, there must also be other factors that explain a large part of the difference in retirement age of men and women.

Figure 9. Share of men working full-time



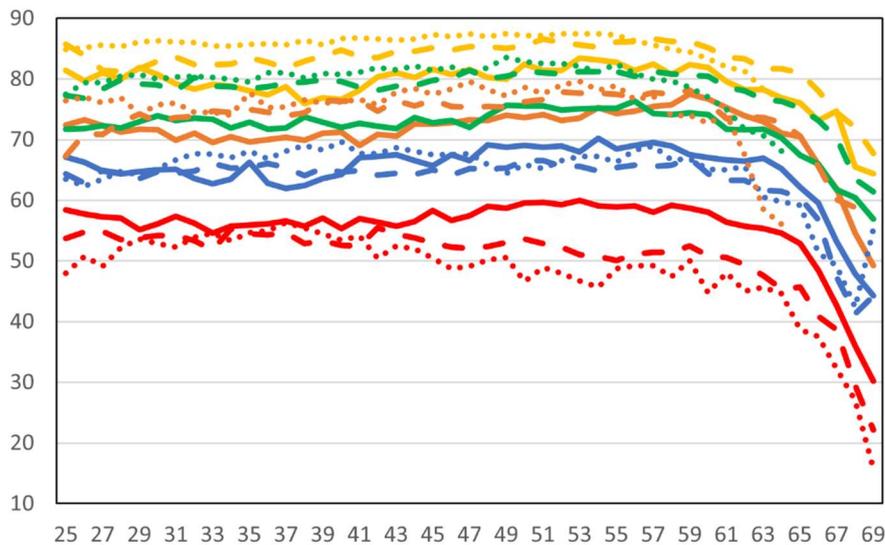
Note: Men working full-time as a share (in %) of all men and women working full-time. Average for the period 2005-2017. The x-axis shows the age of participants.

Sources: Statistics Iceland, Central Bank of Iceland.

As we saw in Figure 8, participation increases with education. Figure 10 shows that it also increases with wage income. People with higher income participate more, which may seem straightforward, as they have "extra" income that they can save. It is possible that people with lower income do not participate more because they are less informed or are less focused on planning for retirement. Figure 10 shows further that, for people within the same income group, the differences in participation rates across various educational levels are relatively small. This indicates that, conditional on income, the differences between participation among people with different educational levels are relatively small, with the possible exception of those in the lowest-income group. This is discussed further in Section 5.

²² Average life expectancy is 80.9 years for Icelandic men and 84.1 years for Icelandic women.

Figure 10. Participation rates, by education, income, and age



Note: Average participation rates (in %) in 2005-2017, by education, income, and age, calculated for Icelanders working full-time. The solid lines indicate participation among those with primary education, the dashed lines those with secondary education, and the dotted lines show participation among those with tertiary education. Participants are divided into five income groups, with red lines representing the lowest-income group, blue lines the second-lowest, orange lines the middle group, green lines the second-highest, and yellow lines the highest-income group. The x-axis shows the age of participants.

Sources: Statistics Iceland, Central Bank of Iceland.

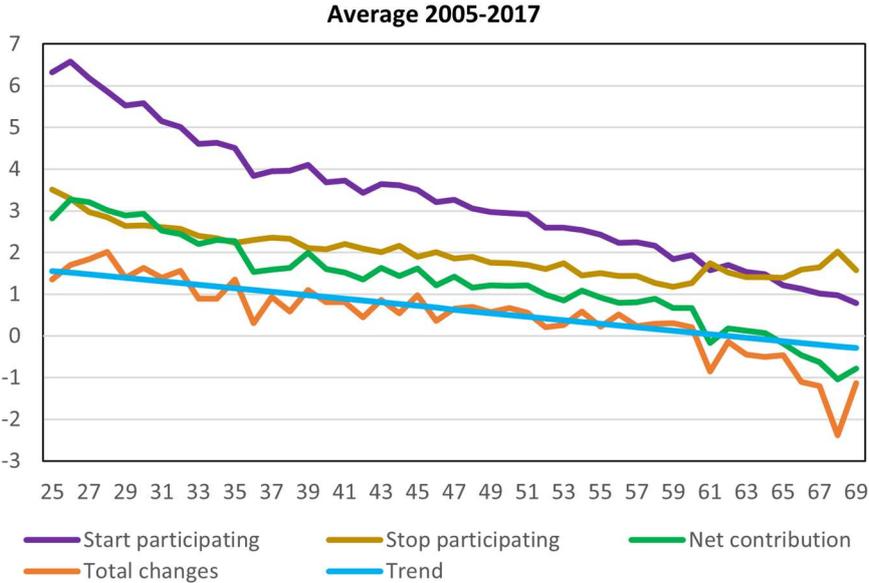
4 Reduced participation after age 60

People can participate in supplementary pension schemes as long as they are active in the labour market, and they can withdraw their supplementary pension savings from age 60 onwards. As the return on the employee's contribution is high because of the matching contribution from the employer, we would expect participation rates to increase after age 60, as savings can be withdrawn with a few weeks' advance notice and liquidity problems are thus unlikely to affect the decision. However, as we saw in Section 3, participation does not increase after 60; it actually declines.

Lusardi and Mitchell (2014) discuss research showing that financial literacy is lowest among the young and the old. This could be a partial explanation; however, the problem here is that when we calculate contributions to changes in participation rates, we observe that the contribution of those who start participating decreases at the same rate after age 60 as before that age, while the contribution of those who stop participating begins to increase (Figure 11). This implies that the main reason for the decline in participation after age 60 is that people who were financially literate enough to participate in supplementary pension savings in a given year stop participating the following year, even if they continue to work full-time, and are thus eligible to participate.

In Figure 11 we see the net contribution of those who both start and stop participating, as well as the total change in the participation rates. We have added a line showing the linear trend for total changes against age, estimated for ages 25 to 59. When this line is used to forecast total changes in participation among those aged 60 to 69, it predicts changes in participation rates well above the line showing actual changes in the rate of decline in average participation after age 60.

Figure 11. Contributions to changes in participation rates



Note: Average contributions to changes in participation rates for Icelandic wage-earners working full-time (in percentage points) in 2005-2017. The x-axis shows the age of participants in the latter year. A more detailed description of these calculations can be found in the Appendix.

Sources: Statistics Iceland, Central Bank of Iceland.

In Section 4.1, we discuss the finding that the probability of stopping participation is greater among those who start to withdraw from supplementary pension savings after 60 than among other groups of Icelanders who work full-time and are eligible to participate. It seems as if some people connect the two actions: 1) starting to withdraw funds from supplementary pension savings; and 2) stopping participation. This could be linked to some lack of literacy, possibly financial literacy. In Section 4.2, we discuss how aggregation can create negative slopes in participation rates calculated from cross-sectional data, even if disaggregated data do not decline with age. After exploring several such possibilities, we find that disaggregated data also show that participation rates decline after age 60, but less than is seen in the aggregate data.

4.1 Connection between the decision to withdraw funds and participate

When people reach age 60, they can start withdrawing funds from their supplementary pension accounts. If they continue to work, they can also continue to save; i.e., they can withdraw and add savings simultaneously. If they want to start withdrawing funds, they notify their chosen

pension custodian, and if they want to stop or start participating in supplementary pension savings, they notify their employer. There seems to be no logical or institutional reason why people who decide to withdraw funds but continue to work and are eligible to participate should be more likely than others to stop participating, yet that is what the data show.

In our data, we have information about withdrawals from supplementary pension savings from 2008 through 2017. This determines the amount of data available to check possible correlations. The cohort born in 1947 was 61 years old in 2008 and 70 years old in 2017. The cohort born in 1952 was 60 in 2012 and 65 in 2017. In order to check possible links between the decision to withdraw funds after reaching age 60 and the decision to stop paying into supplementary pension savings, we must select those who had the option of continuing to participate but did not. For this, we select those who work full-time for at least two years after starting to withdraw their savings, using six cohorts (those born in 1947 through 1952).

Table 4 contains information about participation and withdrawals of supplementary pension savings among Icelandic wage-earners working full-time. The columns in the table show:

- 1) The share of people aged 60-62 who start withdrawing supplementary pension savings but continue to work full-time for at least two more years.
- 2) The share of people aged 60-62 who stop participating but continue to work full-time for at least two more years.
- 3) The *expected* share of people aged 60-62 who start withdrawing supplementary pension savings **and** stop participating while continuing to work full-time for at least two more years, assuming that these two decisions are independent of one another (i.e., (3) = (1)*(2)/100).
- 4) The *actual* share of people aged 60-62 who use the option to withdraw from supplementary pension savings **and** stop participating in the same year, while continuing to work full-time for at least two more years.

Table 4. Participation and withdrawals from supplementary pension savings

	(1)	(2)	(3)	(4)
Cohort born in 1947	24.1	7.6	1.8	3.3
Cohort born in 1948	18.0	8.4	1.5	3.9
Cohort born in 1949	18.5	6.4	1.2	2.7
Cohort born in 1950	15.9	4.3	0.7	2.0
Cohort born in 1951	15.5	4.8	0.7	1.7
Cohort born in 1952	13.4	4.0	0.5	1.6
Average	17.6	5.9	1.1	2.5

Note: Participation and withdrawals are calculated for Icelandic wage-earners working full-time. Column (3) is calculated as (1)x(2)/100. The average is calculated as the average for all six cohorts. Data on withdrawals from supplementary pension savings are available from 2008 onwards.

Sources: Statistics Iceland, Central Bank of Iceland

The share of those who start to withdraw from supplementary pension savings when they are 60-62 years old (Column 1 in Table 4) is highest for the first three cohorts. The explanation for

this is that 2009 was the first year after the onset of the financial crisis, which plunged many households into dire financial conditions. The number of first withdrawals for the cohorts born in 1949 or earlier was highest in 2009, when they were 60-62 years old. After 2009, the number of people aged 60 and over who start to withdraw funds from supplementary pension savings is lower.

The actual share of people who start to withdraw supplementary pension savings at age 60-62 **and** stop participating at the same time even if they continue to work full-time for at least two more years (Column 4 in Table 4) is much higher than the expected share assuming that the decisions are independent (Column 3). The difference in the frequency is between two- and threefold compared to the expected frequency based on the independence assumption. A formal test, assuming binominal distribution for the two decisions, clearly rejects the hypothesis of independence of the decisions.

The reasoning behind combining these two decisions is far from obvious but could be related to Madrian and Shea's (2001) finding that the suggested pension saving rate was interpreted as advice even if it was not. If one starts to withdraw from pension savings, it may seem "natural" to stop saving at the same time.

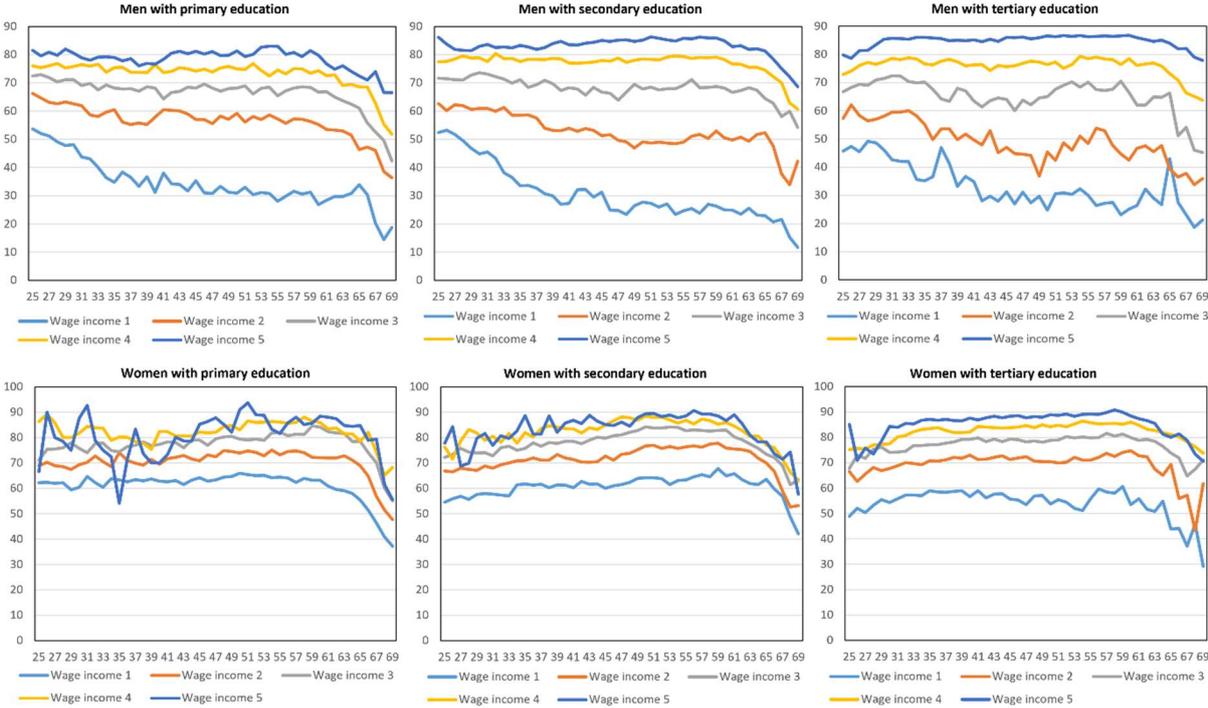
4.2 Effects of aggregation

There are a number of reasons why participation rates for aggregates may decline after age 60 even if the disaggregated rates do not. Because women participate more than men, the declining share of women among those working full-time after age 60, by itself, would result in a declining aggregate participation rate for men and women even if neither participation rate (for men or for women) is declining. Another possibility is that participation is highest among those with tertiary education, and the share of tertiary-educated in cross-sectional data for one year is declining with age. This, by itself, leads to a downward trend in the aggregate participation rate for men and women in cross-sectional data. Of course, there are also tendencies that, by themselves, lead to upward trends in aggregate participation rates even if such trends are not found in disaggregated data. Those with lower income participate less than those with higher income, and they also retire earlier, which increases aggregate participation rates for Icelandic wage-earners over age 60.

The financial institutions that act as custodians for supplementary pension savings frequently advertise that people should start participating in supplementary pension savings in order to be able to retire early. If this advertisement were effective, and a significant number of people participated in supplementary pension savings in order to stop working before age 65-67, when they are eligible for a pension from the basic mandatory pension system and the Social Insurance Administration, then we would expect those who participate to stop working full-time earlier than those who do not participate, thereby contributing to a decrease in the aggregate participation rate, by age, after age 60. When checking this possibility, we found, in fact, that the reverse is true. Non-participants in supplementary pension savings tend to stop working full-time at a younger age than participants do.

We end this overview by presenting figures that show disaggregated participation rates, by gender. The upper row in Figure 12 shows the participation rates for men, and the lower row shows the rates for women. The three panels in each row show three educational groups, from left to right: primary education, secondary education, and tertiary education. There are five groups of wage income in each figure, with each line showing the average participation rate, by age, in 2005-2017.

Figure 12. Participation in supplementary pension, by gender, education, and income



Note: Average participation rates (in %) in 2005-2017. In the upper row, participation rates are calculated for Icelandic men working full-time, and in the lower row, participation rates are calculated for Icelandic women working full-time. The left-hand panel represents participants with only primary education, the middle panel those with secondary education, and the right-hand panel those with tertiary education. Participants are divided into five income groups, with wage income 1 representing the lowest-income group and wage income 5 the highest. In all panels, the x-axis shows the age of participants.

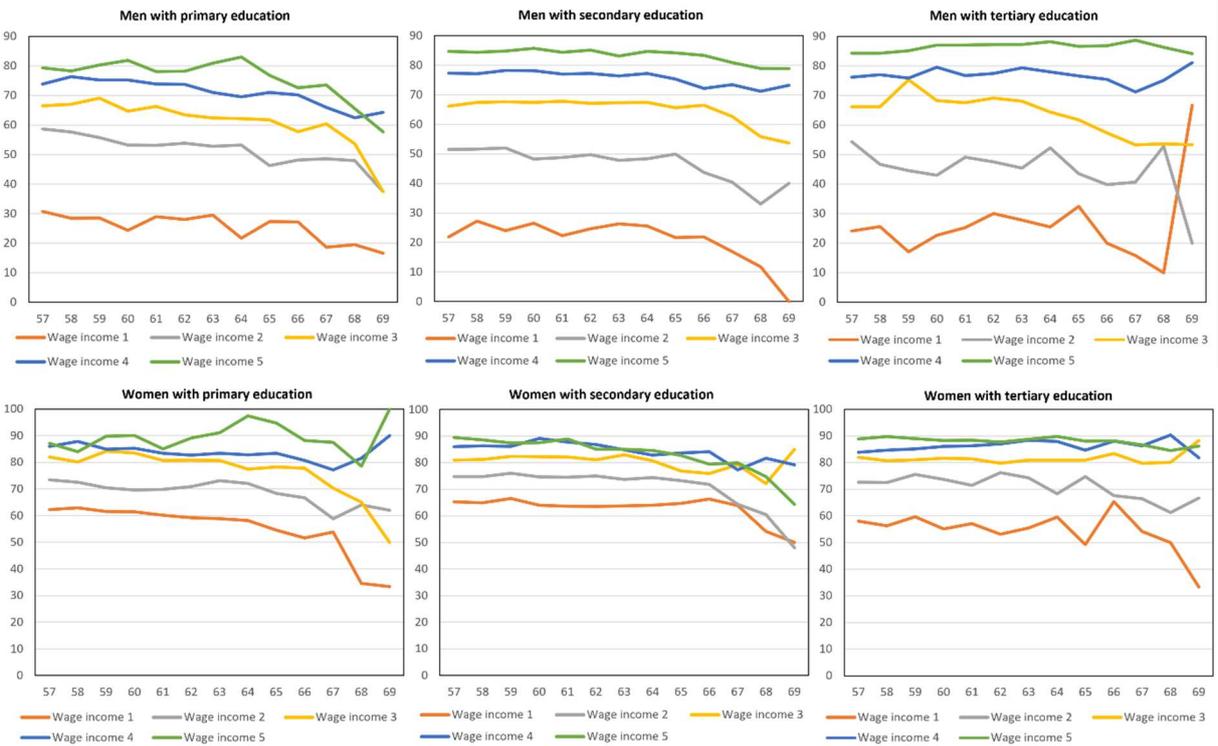
Sources: Statistics Iceland, Central Bank of Iceland.

The figures show that in all cases, participation rates decline among people in their sixties. Estimating linear trends for participation rates, by age, from 55 to 69 years, results in negative slopes in all thirty cases, and significant negative slopes in twenty-nine cases. The only case where the linear trend was not significant was for tertiary-educated men in the lowest-income group (1), a small heterogenous group.

One might suspect that the decline in participation rates in Figure 12 stems in part from two factors: in cross-sectional data, the weight of older generations is greater in older age groups; and each year, older people have less education than younger ones. We therefore calculated the average participation rate against age for available cohorts. Figure 13 shows the same information as Figure 12, except that the averages cover the eight cohorts born in 1948-1955

and aged 57-69 in the sample. The oldest cohort, those born in 1948, was 57 years old in 2005 and 69 in 2017. This means that the averages for different age groups contain differing numbers of datapoints. For the averages up to age 62, data on all eight cohorts are used, but from then on, the average uses data on fewer and fewer cohorts, ending with the “average” of one cohort, those born in 1948, for the “average” of those aged 69.

Figure 13. Participation in supplementary pension savings, by gender, education, and income, for cohorts born in 1948-1955



Note: Average participation rates (in %), calculated for cohorts born 1948-1955. In the upper panel, participation rates are calculated for Icelandic men working full-time, and in the lower panel, participation rates are calculated for Icelandic women working full-time. The left-hand panel represents participants with primary education, the panel in the middle those with secondary education, and the right-hand panel those with tertiary education. Participants are divided into five income groups, with wage income 1 representing the lowest-income group and wage income 5 the highest-income group. In all panels, the x-axis shows the age of participants.

Sources: Statistics Iceland, Central Bank of Iceland.

Using the cohort data to estimate linear trends in participation rates, by age, for the thirty groups gives that twenty out of thirty have a significant negative trend (Figure 13) and another five have a negative trend, although not significant. In five cases, the trend was positive, but in no instance was it significantly positive. One of these cases was tertiary-educated men in the lowest-income group (1). The slope was also positive for tertiary-educated men in the highest-income group (5), for women with primary education in the highest-income group (5, a small group) and tertiary-educated women in income groups 3 and 4.

Comparing the lines in Figures 12 and 13 shows that the negative slope of the lines for participation rates in Figure 12 among people with a tertiary degree and relatively high income

(wage income groups 4 and 5) may be caused by aggregation over different cohorts. It should also be noted that disaggregated data are based on fewer observations and are therefore more variable than aggregated data, making it less likely that the estimated trends are significant.

5 Regression analysis

In this section, we use probit regressions to analyse possible explanatory variables for the probability of participation in supplementary pension savings, using data on Icelandic wage-earners working full-time. Here the aim is to investigate what drives the decision to participate in supplementary pension savings. The terms in the equation show the contribution of the explanatory variables to the estimated probability of participation. First, we estimated a probit equation for each year. The average coefficient estimates and the number of times the coefficients are significant are shown in the first two columns in Table 5. The coefficients of income (here the log of wage income) were always positive and large. We also used two types of data for income: 1) income groups were indexed from 1-5, with the lowest income indexed as 1; and 2) we used dummies for the five income groups. The coefficients for these variables were large and always significant.

The estimated coefficient for the *gender* variable (1 if female, 0 if male) is positive and quite large, which agrees with what others have found when estimating the effect of gender on savings while controlling for income.

The *education* variable has the value 1 when the person has primary education, 2 when the person has secondary education, and 3 when the person has tertiary education. We would expect the coefficient of this variable to be positive and significant because of the positive correlation between education and financial literacy and the expected positive correlation between financial literacy and participation in supplementary pension savings. We saw in Section 3 that the participation rate was highest for those with tertiary education, second-highest for those with secondary education, and lowest for those with primary education. This changes when we estimate the effect of education, conditional upon other variables. It is the variable *income* in particular that causes the effect of education on participation to change from positive to negative. As is shown in Table 5, the average value of this coefficient is -0.057. It is always significant: it was significantly positive in 1999 and 2000, when there were large differences between participation across different educational groups, but significantly negative in other years. The coefficient was negative in 2014, even though participation among those with tertiary education increased most that year, followed by those with secondary education. The estimate of the coefficient increases, however, from -0.081 in 2013 to -0.044 in 2014.

We tried to use dummies for both income and education to relax the restrictions imposed by using the functional form of the logarithm of wage income and the index for education. These experiments did not change anything important. Income continued to be the dominant explanatory variable for the probability of participation, while education was usually

insignificant, and often with the wrong sign. In the case where we used dummies for income-educational groups, the estimates of the coefficients were grouped together. The estimates of the coefficients for the various educational groups within each income group were close together. These results are consistent with what can be seen in Figure 10 in Section 3.2.2, which revealed (conditional upon income) relatively small differences between the participation rates of people with different educational levels.

Like Huberman et al. (2007), we find that taking income into account significantly increases the effect of gender on participation in supplementary pension savings. However, some of this increase may be due to the effect of gender on income, which might be incorrectly identified in the estimated probit equation as an effect on participation. If participation increases with income, as it does, and women's income is significantly lower than that of men, the regression algorithm will forecast lower participation among women than men. Given the option to correct this with a coefficient for gender, the regression algorithm estimates a positive value for this coefficient to compensate for the overly low estimated participation among women because of their lower income. This does not exclude the possibility of a separate gender effect on participation; it merely indicates that such an effect may be difficult to identify.

Table 5 shows the results of estimated probit equations and two-stage probit least squares (2SPLS) equations for the probability of participation. Because we had reason to suspect that participation depended negatively on age for people in their sixties, and since we wanted to test formally whether passing age 60 would affect participation, we included dummies for the age groups from 58-69. As is shown in Table 5, the estimated coefficients of the age dummies are declining, and the number of years when the coefficients are significant declines in the beginning but starts to increase after age 63-64. By age 64, the estimated coefficient is negative and insignificant in all years except three. The estimates continue to decline, and for age 69 the coefficient is -0.381 (-0.346 in the 2SPLS estimation) and significant in all cases except one.

We found that certain other variables are also important for participation. Having a partner who participates significantly affects the probability of participating. The dummy variable *partner participates* was always large, positive, and significant. For those with a partner who participates, the variable *partner participates* has the value 1, and the variable *taxed with partner* is also 1.²³

In all cases, being a homeowner significantly increases the probability of participating. The average contribution is 0.072. Carrying a mortgage loan contributes an average of 0.174 to the probability of participating. The contributions are significant in all cases. Residency matters as well. The average estimated coefficient of the dummy that takes the value 1 if the person lives in the Reykjavik area is -0.059. It is negative and significant in eighteen cases. It is positive and insignificant in one case, in 2006.

²³ In this case, the combined contribution to the probability of participating is $0.852 - 0.227 = 0.625$. For those who are single, *partner participates* is 0 and *taxed with partner* is also 0; therefore, the combined effect is 0. And for those whose partner does not participate, *partner participates* is 0 and *taxed with partner* is 1, resulting in a combined effect of $0 - 0.227 = -0.227$.

Table 5. Results from estimating probability of participation in supplementary pension savings

	Using Probit		Using ivProbit		Total effect
	Average Coef. 1999-2017	No. of times significant	Average Coef. 1999-2017	No. of times significant	Average 1999-2017
Wage income	0.795	19	0.829	17	
Education	-0.057	19	-0.075	16	0.099
Gender	0.330	19	0.373	19	0.032
Age 58	0.069	10	0.071	11	0.065
Age 59	0.070	11	0.073	12	0.071
Age 60	0.051	7	0.055	8	0.069
Age 61	0.030	4	0.036	5	0.053
Age 62	0.023	4	0.032	4	0.051
Age 63	0.010	2	0.021	3	0.042
Age 64	-0.013	3	0.003	2	0.025
Age 65	-0.048	6	-0.028	3	0.011
Age 66	-0.115	12	-0.083	9	-0.025
Age 67	-0.210	16	-0.174	13	-0.063
Age 68	-0.319	18	-0.287	17	-0.132
Age 69	-0.381	18	-0.346	18	-0.176
Partner participates	0.852	19	0.818	19	0.846
Taxed with partner	-0.227	19	-0.215	19	-0.219
Homeowner	0.072	16	0.068	18	0.116
Housing loan	0.174	19	0.168	16	0.228
Works in public sector	0.173	14	0.173	16	0.149
Works in finance and insurance	0.569	19	0.561	19	0.782
Lives in Reykjavik area	-0.059	18	-0.058	13	-0.010

Note: The table reports regression results, where the first two columns show average coefficient estimates for 1999-2017 from probit equations and number of times the coefficients are significant. The third and fourth columns (from left) report estimates using two-stage probit least squares (2SPLS), where the log of wage income is defined as an endogenous regressor using the explanatory variables in the equation for participation and adding age and age² as instruments for identification. Average coefficient estimates taken for the period 1999-2017 are reported. The fifth column reports the total effect, taking into account the effects of income. This is done by taking the estimated coefficient of the variable from the third column in Table 5 for individual years and adding the estimated coefficient of the same variable in the income equation in Table 6, weighted with the estimated coefficient for income in Table 5. The table reports the average of estimated coefficients for the period 1999-2017. The variable *wage income* is the log of wage income.

Source: Authors' calculations.

People working in the public sector are slightly more likely to participate, on average. This was not so in the beginning, and for 2002 and 2004 the estimated coefficient is negative and insignificant. This changed in 2005-2006. The average value of this coefficient is 0.173. The effect of working in the finance and insurance industry is much greater. The average value of this coefficient is 0.569. It can be expected that financial literacy is high in this sector, but it should be noted that the high level of participation in supplementary pension savings in the financial industry is found for all educational groups and all income groups. Easy access to information about supplementary pension savings in the industry could be a driving factor.

Besides showing the results from the probit regressions for the nineteen years, Table 5 also shows the results from estimating a probit equation for the nineteen years using 2SPLS, where

the log of wage income is defined as an endogenous regressor. We use the same explanatory variables as in the probit equation reported in Columns 1 and 2 of Table 5, but we add age and age² as instruments for identification. We tested for the endogeneity of the endogenous regressor and found that for sixteen out of nineteen years the null hypothesis of the log of wage income being exogenous is rejected, most of the time with zero probability of accepting. Columns 3 and 4 in Table 5 show the results for the 2SPLS estimation of the probability of participation. Comparing the averages of the estimated coefficients of the probit equations for participation in Table 5 reveals only small differences. The differences between the two sets of estimates for individual years are larger.

The column at the far right in Table 5 show the value of the contribution of the exogenous variables if we add to the direct effect the indirect effect through the estimated wage equation.

Table 6. Results from estimating the equation for wage income

	Average Coef. 1999-2017	No. of times significant
Education	0.204	19
Gender	-0.386	19
Age 58	0.001	7
Age 59	0.006	7
Age 60	0.026	12
Age 61	0.031	11
Age 62	0.037	12
Age 63	0.042	12
Age 64	0.047	13
Age 65	0.072	13
Age 66	0.106	14
Age 67	0.176	16
Age 68	0.225	19
Age 69	0.246	19
Partner participates	0.032	19
Taxed with partner	0.002	9
Homeowner	0.060	19
Housing loan	0.073	19
Works in public sector	-0.026	18
Works in finance and insurance	0.298	19
Lives in Reykjavik area	0.062	19
Age	0.046	19
Age ²	-0.0005	19

Note: The table reports regression results from an estimated equation for the log of wage income, using 2SPLS. Coefficients are averages for the period 1999-2017.

Source: Authors' calculations.

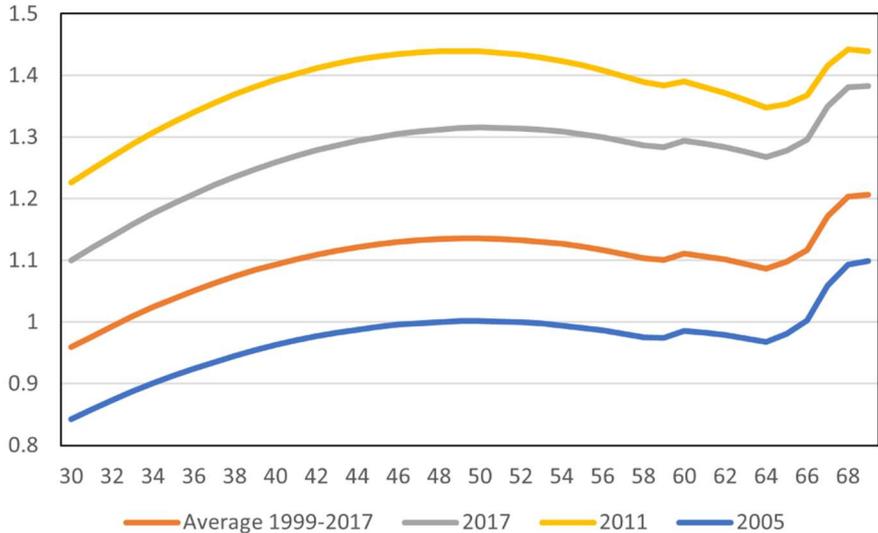
Table 6 shows the averages of the estimated coefficients of the equation for the log of wage income. Here the coefficients for education are always positive and always significant, while

the coefficient for gender is always negative and significant. The coefficient for gender is slowly increasing, indicating that the differences between men’s and women’s wages decreased in Iceland during the period 1999-2017.

The coefficients of variables other than education, gender, and age dummies are mostly significant, but small. One exception is the coefficient for working in finance and insurance. Living in the Reykjavík area has a significant positive effect on income, while working in the public sector has mainly negative effects on income. The coefficients for *Age* and *Age*² are significant, with the correct signs, and stable. They give estimates of the age when income reaches its maximum, from 48.5 years to 51.6 years.

The estimated age dummies show significant deviations in aggregate income from the standard (Mincer) shape of the relationship between age and income. The age dummies for people in their sixties increase with age, so that the income age curves showing the total effect of the dummies and the outcomes of the second-order term, $a \cdot age + b \cdot age^2$, are upward-sloping for these age groups (Figure 14). This steeper upward slope at the end reflects the fact that people with higher incomes stop working full-time later than those with lower incomes.

Figure 14. Estimated total effect of age on income



Note: The x-axis shows the age of participants.

Source: Authors’ calculations.

The last column in Table 5 shows the average coefficients for the variables that take into account the effect of income. This is done by taking the estimated coefficient of the variable in the participation equation (the middle column in Table 5) and adding the estimated coefficient of the same variable in the income equation in Table 6, weighted with the estimated coefficient for income in the participation equation. The estimated coefficients for education, obtained in this way from estimations of data for the years 1999-2017, are all positive. The average is 0.099, as is shown in Table 5. The estimated coefficient for gender, obtained in this way, is much lower

than the one in the participation equation. It is positive for thirteen years but negative for six years, including the five years from 1999 through 2003. The average for all nineteen years is 0.032.

Most of the other estimates change only a little compared to the estimates in the participation equation, as their coefficients in the income equation are small. The main exception is the coefficient of the dummy for working in finance and insurance. The estimated coefficient of this variable is always significant and positive in the income equations.

The coefficient for living in the Reykjavik area is always positive in the equations for income, and the average value is 0.062. The coefficient for this variable in the participation equation is negative in the equations for seventeen years and positive in the equations for two years. It is significant thirteen times, and the average is -0.058. When the effect through the income equation is taken into account, the average effect on participation becomes -0.010. The estimated coefficients are positive in the equations for nine years and negative in the equations for ten years.

6 Tax-free payments towards mortgage principal

In 2014, Parliament passed a new law authorising pension fund members to allocate supplementary pension contributions tax-free towards their mortgage loan principal.²⁴ This option significantly increases the benefits of participating in supplementary pension savings. Before it was introduced in 2014, the main benefit of participating was the matching employer contribution of 2%, but the benefit of the tax exemption introduced in 2014 were greater still, especially for those earning high income. Those who pay the highest marginal tax rate of 46.25% (according to the tax code as of 2023), and contribute 4% of their wage to supplementary pension savings and receive 2% from their employer, receive a tax benefit of $0.4625 \times 6\% = 2.775\%$ of the gross wage. If we add the net of tax benefit from the 2% matching contribution amounting to $(1 - 0.4625) \times 2\% = 1.075\%$, we end up with a total net of tax benefit of 3.85% of the gross wage. Those paying highest marginal tax have to receive 7.16% of the gross wage to obtain 3.85% of the gross wage net of tax. The value of the benefits from paying towards mortgage principal as a percentage of wage income varies with income, and as the maximum nominal amounts have remained the same since 2014 the size of the benefits from paying towards mortgage principle has gradually declined as a percentage of the wage.

In 2014, 25,609 wage-earners took advantage of this option; by 2015 that total had reached 32,536; and by the final year of our data, it had risen to 37,762, or 32.2% of all those carrying mortgage debt. Interestingly, given how favourable this option is, these numbers are

²⁴ The allocation was capped at 500,000 Icelandic krónur (3,333 euros) per year for single persons and 750,000 krónur (5,000 euros) per year for couples. There is also an upper limit on the share of wages that can be used in this manner: a 4% contribution from the wage-earner and a 2% matching contribution from the employer. Further information can be found on the Iceland Revenue and Customs website (RSK, <https://leidbeiningar.rsk.is/frodi/?cat=942>). Originally, this option was to be available from 1 July 2014 through 30 June 2017, but the provision was extended, first to 30 June 2019, then to 30 June 2021, and finally, to the current expiry date of 31 December 2024 (Act no. 51/2023, <https://www.althingi.is/alttext/stjt/2023.051.html>).

considerably lower than expected. In the calculations provided with the bill of legislation preceding the 2014 law, the number of participants was estimated at 42,000-55,000, or 35-50% of those carrying mortgage debt.²⁵

To assess the effect of this new option on participation in supplementary pension savings, we calculated the changes in participation from 2013 to various later years after the option had been implemented. Table 7 shows supplementary pension savings participation among Icelandic wage-earners aged 30-69. The upper half of the table shows participation rates for those with mortgage debt, while the lower part shows participation rates for those without it.

The columns in Table 7 show participation rates for those who were wage-earners in two specified years: 2013 and one other year.²⁶ The second year is 2014 in the first column, 2015 in the second column, and so on. We excluded all those whose family status (single or married/partnered) and taxation status (taxed jointly or separately) changed in the interim.

Table 7. Participation rates for Icelanders with and without mortgage debt

	2013/2014	2013/2015	2013/2016	2013/2017
Owe housing debt in 2013	66.4	65.9	65.1	64.7
Owe housing debt in the latter year	74.6	75.4	76.3	77.8
Change (percentage points)	8.1	9.5	11.1	13.1
No housing debt in 2013	51.4	50.5	49.8	50.3
No housing debt in the latter year	56.1	55.5	55.8	57.7
Change (percentage points)	4.7	5.1	6.0	7.4

Note: The table reports participation rates (in %) in 2013-2017 for Icelandic wage-earners aged 30-69. The upper half shows participation rates for those carrying mortgage debt, while the lower part shows participation rates for those with no mortgage. It also reports changes in participation (in percentage points) from 2013 and to various later years after the option of allocating supplementary pension savings tax-free to mortgage loans had been implemented.

Source: Authors' calculations.

The share of mortgage holders who participated in supplementary pension savings was 66.4% in 2013 but had increased to 74.6% in 2014. Of those carrying a mortgage in 2013 and 2015 (not the same group as those with mortgage debt in 2013 and 2014), the participation rate rose from 65.9% in 2013 to 75.4% in 2015. By 2017, the participation rate for those with a mortgage had increased by 13.1 percentage points relative to 2013.

For those without a mortgage in 2013, 51.4% participated in supplementary pension savings, but for this group as well, participation increased over time, rising by 7.4 percentage points from 2013 to 2017, or more than half of the increase among those carrying a mortgage. The large increase in participation among those who could not benefit from the new tax-free allocation to mortgage principal indicates that other factors affected participation for both groups. One likely explanation is that the new option received substantial media coverage in

²⁵ Amendments to Act no. 129/1997 are discussed in Parliamentary Document no. 836: <http://www.althingi.is/alttext/pdf/143/s/0836.pdf>.
²⁶ Note that in Table 7 we used data on all Icelandic wage-earners aged 30-69, but in Table 3 we used data on all Icelandic wage-earners working full-time and aged 25-69.

2014. Also, as is discussed in Section 3, the new legislation gave non-homeowners the option of depositing their supplementary pension contributions to dedicated housing accounts that could be used tax-free towards a later home purchase. Unfortunately, our dataset contains no information about these savings; it shows only those who withdrew funds from these accounts to pay for a home. The data show that 1,574 persons did so in 2016 and 1,699 in 2017.

As is discussed in Section 3, participation rates declined in the aftermath of the financial crisis (2009-2010) and remained subdued until 2014, when they rebounded to a level similar to that seen before the crisis. As is noted there, after the crisis, young people had stopped participating in supplementary pension savings to a greater extent than their elders. In 2014, however, it was participation among younger age groups that increased more strongly, making the curve for participation against age horizontal again from age 30 to age 60.

There are also large differences in participation across income groups, as is shown in Table 8. Of those carrying a mortgage, those in the lowest income bracket were least likely to make tax-free payments towards their housing debt, and they were also slower to respond to the new option. Only 3.1% chose this option in the first year, 2014. By 2017, however, this share had more than doubled, to 7.7%. For those with the highest income, these numbers were 47.6% and 58.2%, respectively.

Table 8. Share of Icelanders with mortgage debt who opt for tax-free payments, by income

Income group	2014	2015	2016	2017
Lowest 20%	3.1	5.3	7.2	7.7
20-40%	9.4	13.6	15.0	17.8
40-60%	17.6	23.5	26.4	29.0
60-80%	29.1	36.4	39.4	41.5
Highest 20%	47.6	55.6	57.5	58.2

Note: The table reports the share (in %) of Icelanders with mortgage debt who opted to make tax-free payments towards their mortgage principal, by income. The shares are calculated for Icelandic wage-earners aged 30-69. Wage-earners are divided into five income groups, from the 20% with the lowest income to the 20% with the highest.

Source: Authors' calculations.

Education also affects people's decision to choose to make tax-free payments towards mortgage principal (Table 9). Those with tertiary education responded much more rapidly to the option introduced in 2014: that year, the tertiary-educated share was almost three times the share of those with primary education, but by 2017 it was slightly more than twice the share of those with primary education.²⁷

²⁷ Those with higher education were also quicker to begin participating in supplementary pension savings at the start, in 1999 and 2000, resulting in significant positive coefficient estimates for the *education* variable in probit equations for these years, as is noted in Section 5.

Table 9. Share of Icelanders with mortgage debt who opt for tax-free payments, by education

	2014	2015	2016	2017
Primary education	12.9	17.2	19.5	21.2
Secondary education	22.0	27.6	29.8	31.4
Tertiary education	35.9	42.7	44.5	45.3

Note: The table reports the share (in %) of Icelanders owing mortgage debt who opt for tax-free payments towards their mortgage principal, by education. The shares are calculated for Icelandic wage-earners aged 30-69.

Source: Authors' calculations.

It is to be expected that foreign wage-earners who own a home in Iceland are more integrated into Icelandic society than foreign wage-earners in general. Table 10 shows that this does not apply to making tax-free payments towards mortgage principal.

Table 10. Share who opt for tax-free payments towards mortgage principal

	2014	2015	2016	2017
Icelandic wage-earners	28.6	35.2	37.6	39.2
Foreign wage-earners	8.0	10.6	13.5	15.9
Total (all wage-earners)	27.8	34.3	36.7	38.2

Note: The table reports the share (in %) of those who opted to make tax-free payments towards their mortgage principal as a percentage of all who carry mortgage debt. The shares are calculated for wage-earners aged 30-69.

Source: Authors' calculations.

Those carrying mortgage debt can choose: (1) to participate in supplementary pension savings and make tax-free payments towards their mortgage principal; (2) to participate in supplementary pension savings but not make tax-free payments towards their mortgage principal; and (3) not to participate in supplementary pension savings. Table 11 shows the share of Icelandic wage-earners aged 30-69 who fall into these three groups relative to the total number of those carrying mortgage debt. It is striking that in 2017, only 39.2% of those with a mortgage were participants who chose to make tax-free payments towards their loan principal. This share was slightly larger than the share of mortgage holders who participated in supplementary pension savings but did not choose the tax-free option.

Table 11. Participation and the tax-free option

	2014	2015	2016	2017
(1)	28.6	35.2	37.6	39.2
(2)	46.0	40.3	38.8	38.8
(3)	25.4	24.4	23.6	22.1
Total	100.0	100.0	100.0	100.0

Note: The table reports the share (in %) of all those carrying mortgage debt. Row (1) represents those who chose to make tax-free payments towards loan principal; Row (2) includes those who participated in supplementary pension savings but did not avail themselves of the tax-free option; and Row (3) shows those who did not participate in supplementary pension savings but carried a mortgage. The shares are calculated for Icelandic wage-earners aged 30-69 who carry mortgage debt.

Source: Authors' calculations.

7 Conclusions

This paper discusses participation in supplementary pension savings in Iceland. Given the generous subsidies offered, participation is low. Economic research (see, for instance, Madrian and Shea, 2001, and Chetty et al., 2014) indicates that an important reason for this might be that, when faced with several options, people tend to choose the one that is given as a default and requires no or little action on their behalf. Madrian and Shea (2001) also report that making participation in the pension savings that they studied the default choice (changing from an opt-in format to an opt-out format) increased participation most among the groups least likely to participate before the change was made. It is therefore possible that a large share of those who do not participate in supplementary pension savings in Iceland would do so if everyone were enrolled by default and informed that they could opt out if they so chose. It would be interesting to test this in Iceland; e.g., through an agreement between employers and some labour unions.

The rate of return on supplementary pension savings increases with age. If a high subjective discount rate induces some people not to participate, we would expect participation rates to be upward-sloping with age. This is not the case. For the largest and the most homogeneous group – Icelandic wage-earners working full-time – participation is more or less constant from age 30 to age 60. At age 60, when people can begin to withdraw their supplementary pension savings, participation rates actually decline, contrary to expectation. In Sections 4 and 5, we analysed possible reasons for the decline in participation and found that the decline among all Icelandic wage-earners working full-time was influenced by two factors: women participate more than men but retire earlier; and older people generally have less education, yet more education makes participation more likely. We also found that those who started to withdraw from their supplementary pension savings accounts were more likely to stop contributing to them even if they continued to work full-time and thus remained eligible to participate. The reason for this behaviour is not obvious.

We identified several factors that could explain some of the decline in participation, by age, in cross-sectional data after age 60, and we were also able to establish that these explanatory factors were not exhaustive. Controlling for factors like education, gender, and age did not eliminate the downward trend in participation after age 60.

New legislation that entered into force in 2014 allows supplementary pension savings participants to allocate both their payments and the matching employer contribution, tax-free, towards their outstanding mortgage principal. Participation in supplementary pension savings increased by some 6 percentage points with the enactment of the new law, although participation in the new mortgage principal reduction option was below Government forecasts. Although the number of Icelandic wage-earners who take advantage of this option has been increasing, only 39.2% of all Icelandic wage-earners carrying mortgage debt did so in 2017, and 38.8% of those carrying a mortgage chose not to, even though they participated in supplementary pension savings. Among foreign wage-earners, the uptake rate was even lower, at 16% in 2017.

We find that participation among women, either single or partnered, exceeds that among men for all except the youngest and oldest age groups. The differences between participation rates among single men and single women are larger than between men and women with partners.

We find that other variables – income and gender – are significant explanatory variables in probit equations estimating coefficients for the variables that explain the probability of participation in supplementary pension savings. We do not have data on financial literacy, but we do have data on education. We find that education is positively correlated with participation, but its coefficient becomes insignificant and often negative when income is included in the probit equation. At the same time, education is positively correlated with income. To explore the possibility of income being endogenous, we estimated two-stage probit least squares (2SPLS) equations. We estimate the equation for nineteen years in our dataset, from 1999 through 2017, and find that in sixteen cases the null hypothesis of exogeneity of the log of wage income is rejected. We further find that the log of wage income is concave in age, except after age 65, when it starts to increase because people with higher incomes tend to retire later than those with lower incomes. Calculating the total effect of education through the equation for the log of wage income and the equation for the probability of participation gives reasonable positive coefficients for education. The same types of calculations for gender, which is a large significant explanatory variable for the log of wage income, also gives a positive coefficient in most cases, indicating that women are more likely to participate than men.

Large datasets allow the researcher to explore many possibilities. One hypothesis that we wanted to test was whether participation in supplementary pension savings affected other saving. It was explicitly stated in the 1997 legislation on supplementary pension savings that the aim was to increase saving in Iceland. Traditional economic analysis of the effects of efforts to increase saving by adding subsidies to some form of savings gives mixed results. It can be expected that people move their savings into subsidised accounts, but they may do so by reducing other saving. Even if higher rates of return are incentives for increased saving, it also implies higher incomes and therefore more consumption. The net outcome depends on which is stronger, the substitution effect from higher returns or their income effect. Econometric studies that have tried to measure these effects have reached varying conclusions.²⁸

We tried to use our data to determine whether there were significant differences in other forms of saving among supplementary pension savings participants and non-participants. We were not able to detect such effects.

There are important measurement problems in this type of research. It should also be noted that the 2008 financial crisis did affect saving in Iceland. As is documented above, participation in supplementary pension savings declined after the crisis, but at the same time gross macroeconomic saving increased. While the average ratio of macroeconomic saving to GDP was 19.5% in 1999-2007, it was nearly 5 percentage points higher, or 24.4%, in 2008-2017.

²⁸ Bernheim (2002) discusses this research.

During the period after the supplementary pension savings scheme was introduced, the ratio of gross macroeconomic saving to GDP declined, reaching a low of 17.1% in 2005. At the same time, the rate of participation in supplementary pension savings stopped rising. Several recent and ongoing research projects use the rich panel of annual data provided by Statistics Iceland, which we used for the study presented here. Several of these projects focus on consumption and saving. One of them is discussed in Sveinsson et al. (2022). This paper and future research will fill some gaps in the research presented in this paper.

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Appendix A: Contributions to changes in participation rates

The columns in Table A.1 show the number of people falling into three categories in year $t-1$: 1) those working full-time and participating in supplementary pension savings (WF, P); 2) those working full-time and not participating (WF, NP); 3) those not working full-time and either participating or not (NWF, P/NP).

Table A.1

		year t-1		
		1=(WF, P)	2=(WF, NP)	3=(NWF, P/NP)
year t	1=(WF, P)	F(1, 1)	F(2, 1)	F(3, 1)
	2=(WF, NP)	F(1, 2)	F(2, 2)	F(3, 2)
	3=(NWF, P/NP)	F(1, 3)	F(2, 3)	F(3, 3)

The rows in Table A.1 show the number of people who belong to the same groups in year t . $F(1,1)$ in upper left-hand corner is the number of people working full-time and participating in both year $t-1$ and year t . $F(2,1)$ is the number of people working full-time but not participating in year $t-1$, but working full-time and participating in year t . This, then, represents those who worked full-time in both years and started to participate in year t . $F(1,2)$ is the number of people who worked full-time in both years and participated in year $t-1$, but not in year t ; i.e., those who stopped participating in supplementary pension savings in year t .

Using this, we can express the number of people working full-time in year $t-1$ as:

$$F(t-1) = \sum_{i=1}^3 [F(1, i) + F(2, i)]$$

and the number of people working full-time in year t as:

$$F(t) = \sum_{i=1}^3 [F(i, 1) + F(i, 2)]$$

The participation rate in year $t-1$ is

$$R(T-1) = [F(1,1) + F(1,2) + F(1,3)]/F(T-1)$$

and the participation rate in year t is

$$R(T) = [F(1,1) + F(2,1) + F(3,1)]/F(T)$$

The change in the participation rate between years $t - 1$ and t is then expressed as:

$$\begin{aligned} \Delta R(T) = & [F(2,1)/F(T) - F(1,2)/F(T - 1)] + [F(1,1)/F(T) - F(1,1)/F(T - 1)] \\ & + [F(3,1)/F(T) - F(1,3)/F(T - 1)] \end{aligned} \quad (\text{A.1})$$

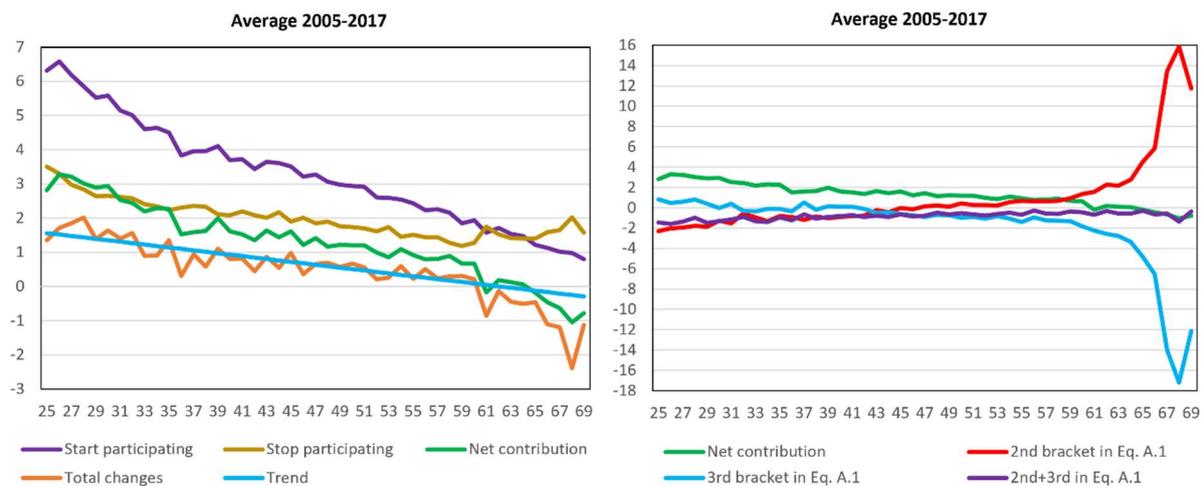
In the first brackets on the right-hand side is the difference between the contribution to the change in the participation rate by those who start participating in year t and those who stop participating in that year while working full-time in both years. In the second brackets is the difference in the contribution of those who are working and participating in both years. For age groups between 30 and 60, the differences between $F(T)$ and $F(T - 1)$ are relatively small, and the term in the second brackets is therefore small, but after age 60 the total number of those working full-time starts to decline faster, causing the outcomes from the second brackets to increase.

The expression in the third brackets shows the differences between the contributions to the participation ratio of those not working full-time in year $t - 1$ but working full-time and participating in year t , on the one hand, and those working full-time and participating in year $t - 1$ but not working full-time in year t , on the other hand. For age groups between 30 and 60, the differences between the nominators of the two terms are small as well as the differences between the denominators which makes outcomes of the third bracket small. After age 60, the share of those who worked full-time in year t and participated but did not work full-time in year $t - 1$ declines, while the share of those working and participating in year $t - 1$ who did not work full-time in year t increases, causing the outcomes of the third brackets to decrease (i.e., become more negative).

Plotting the terms in Equation A.1 against age gives quite regular and often nearly linear plots. Figure A.1 on the left shows average contributions to changes in participation rates, by age, for changes between consecutive years from 2005 through 2017. The right-hand panel shows the net contribution of those who start to participate; the green line is the same in the two figures. This right-hand panel also contains lines for the contribution to the total change in participation rate, by changes in the number of wage-earners working full-time (terms in the second brackets on the right-hand side in Equation A.1), the contribution of those who started working full-time or stopped working full-time (terms in the third brackets on the right-hand side in Equation A.1), and the sum of these two.

The line showing the contribution of those who did not participate in the first year and started to participate in the latter year, but worked full-time in both years, starts highest and declines almost linearly. The line showing the contribution of those who stopped participating while continuing to work full-time starts lower and declines more slowly than the first line. After age 60, the line shows a slow increase in the contribution of those who stop participating while continuing to work full-time. The third line shows the outcomes from the expression in the first brackets; i.e., the difference between the two first terms. The fourth line shows the changes in participation rates given by Equation A.1. It is quite close to the line showing the outcomes from the first brackets in Equation A.1. It follows that, on average, the sum of the outcomes from the second and the third brackets is small, as is shown at the right in Figure A.1.

Figure A.1. Contributions to changes in participation rates



Note: The left-hand panel shows contributions to changes in participation rates (in percentage points), on average, in 2005-2017. The x-axis shows the age of participants in the latter year. The right-hand panel shows more detailed contributions to changes in participation rates (in percentage points), on average, in 2005-2017, based on Equation A.1 in the Appendix. The horizontal axis shows the age of participants in the latter year.

Sources: Statistics Iceland, Central Bank of Iceland.

