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Pension Fund Asset Allocation, Household Investments and Capital Market Depth

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Pension Fund Asset Allocation, Household Investments and Capital Market Depth*

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Abstract

The global shift towards defined contribution pension schemes significantly increases households' exposure to equity markets through their pension savings. Does this shift influence households' non-pension investment choices, and if so, why? Investigating a pension fund reform and using multiple identification strategies, we show that households increase their non-pension equity holdings following an increase in the equity exposure of their pension fund, thereby contributing to deeper capital markets. We interpret our results within the framework of a simple model, illustrating how equity exposure via pension savings can lower barriers to stock market participation for non-pension investments.

Keywords: household finance, stock market participation, pension savings, defined contribution

JEL Classification: D14, G11, G23, G41, G51

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Introduction

Over recent decades and to today, pension savings are shifting from defined benefit to defined contribution schemes (OECD, 2022; PensionsEurope, 2024). As a result, individuals are becoming increasingly exposed to the returns and risks of financial markets through their pension savings. A key question is whether these fundamental changes in pension saving schemes influence individuals' non-pension decisions. If they do, the implications for financial markets are significant: pension funds would not only affect markets through their own portfolio choices, but also indirectly through the induced behavior of their customers, potentially leading to *capital market deepening* in the sense of Scharfstein (2018). If they do not, this has implications for standard portfolio theory, which assumes that individuals optimize their total wealth portfolio, encompassing both pension and non-pension assets.

Building on research on households' risk taking in pension investments (e.g. Benartzi and Thaler, 2001, 2007; Choi, Laibson and Madrian, 2009) and in non-pension investments (Vissing-Jørgensen, 2003; Calvet and Sodini, 2014), a growing literature has begun to examine the link between the two domains, including Weisbenner (2002), Dahlquist, Setty and Vestman (2018), Smirnova (2024), and Parker et al. (2025). Our contribution to this literature is threefold. First and foremost, we leverage variation in pension product offerings to show that greater equity exposure in pension savings causally increases equity investments outside pension accounts, thereby advancing the literature beyond studies based on correlations. Second, we use our estimates to provide broader context for why this effect matters: building on Scharfstein (2018)'s insight that pension fund investment can drive capital market deepening, we offer a micro-founded estimate of the magnitude of this mechanism. Finally, we develop a theoretical framework to elucidate the economic forces underlying this connection and to distinguish among alternative explanations for why pension investments can affect individuals' non-pension saving choices.

In our empirical investigation, we exploit a Danish pension reform. In 2011–12, a large Danish pension fund offered its members the opportunity to change from a pension product with low equity market exposure (a "guaranteed" product) to a product with high equity market exposure (a "market-sensitive" product). This change mirrors pension reforms in other countries that place greater investment responsibility and risk on individual savers as they shift towards defined-contribution plans. When given the opportunity to change pension products, individuals in our setting received information regarding risks and returns in the two products, and specifically that higher financial risks are associated with higher expected returns.

Analysing proprietary data from this pension fund, coupled with third-party reported data from individual investor registries, we investigate whether these individuals also became more likely to invest in the stock market using their non-pension portfolios. Our underlying hypothesis is that the unexpected and exogenously given opportunity to change the stock market exposure in households' pension plans, along with the information they received, effectively lowered their stock market participation costs. This, in turn, can encourage affected households to invest more in the stock market using their non-pension wealth.

Our empirical analysis compares individuals who changed to the high equity exposure pension product to a matched sample of members who did not change products. We match individuals exactly on investment behaviour in the years leading up to the product change—for instance that both the treatment and control groups did not invest in stocks using non-pension savings before the switch of pension products—and we use propensity score matching to ensure they are also closely matched on a large set of other economic and demographic control variables. We then compare the subsequent stock market participation rates in the non-pension portfolios of pension fund members who changed pension products with the participation rates of members who did not change products.

We find that members who become more exposed to the stock market in their pension plan are more likely to enter the stock market in their non-pension portfolios than members whose exposure to stocks did not change. The effect is persistent: with each year that passes since the product change, more and more affected individuals enter the stock market. Seven years after the change of pension products, affected individuals are seven percentage points more likely to enter the stock market with their non-pension portfolio, compared to non-affected individuals. Since the average stock market participation rate in our sample is 35%, the effect corresponds to a 20% increase in the overall probability of stock market participation, an economically large effect. Overall, this means that pension fund investments influence individuals' investment decisions, and, as a result, the depth of capital markets.

Our finding that an increase in households' risky allocation in their pension fund increases their participation in the stock market using non-pension savings goes against standard economic theory that predicts that households who consider the risk of their entire wealth portfolio should decrease the risky asset allocation of their non-pension savings in such situations (e.g. Mayers and Smith, 1983; Abel, 2001). The results similarly speak against the hypothesis that investors consider their pension account and non-pension accounts as separate mental accounts disconnected from each other (Thaler, 1985; Choi, Laibson and Madrian, 2009). So to help us interpret our empirical findings, we develop a simple two-period model comprising working period and retirement period. The model draws on a

large literature (e.g. Vissing-Jørgensen, 2003; Gomes and Michaelides, 2005) which argues that individuals face participation costs when investing in stock markets. Importantly, this literature has also shown that these costs decrease when people receive information about the stock market; see, e.g. Hong, Kubik and Stein (2004), Christiansen, Joensen and Rangvid (2008) or Hvide et al. (2022). Specific to our question, Scharfstein (2018), who studies how pension policy affects the structure of the financial system, which he labels *capital market deepening*, suggests that people might become more familiar with stock markets through their pension savings, which reduces the non-pecuniary cost of participation and leads more people to participate.

In our model, which is inspired by our empirical set-up, investors decide how much to consume while working and how much to save for retirement, while also making decisions regarding their pension and non-pension investments. Regarding their pension investments, investors choose whether to stay with their default pension product, which is invested safely and provides a relatively low return, or to change to a pension product with a higher stock market exposure to achieve a higher expected return, which is paid out during the retirement period. Regarding their non-pension investments, investors who choose the pension product with the higher stock market exposure will face a lower barrier to entry into the stock market when investing their non-pension savings. The lower barrier to entry can be interpreted broadly. Besides the direct learning that we focus on, this may also capture more optimistic return expectations and interpreting the offer to change pension products as an impetus to become active with non-pension assets, all of which may lead to capital market deepening.

Our model shows that when investors encounter reduced barriers to stock market entry via their pension savings, they tend to increase the equity exposure of *both* their pension and non-pension savings, in contrast to standard portfolio theory (see, e.g., Abel (2001)), but in accordance with our empirical findings.

Our results can be viewed as providing a micro foundation for Scharfstein's (2018) modeling of the general-equilibrium macroeconomic spillover effects of pension funds' asset allocations. Building on our findings - that pension funds cause capital market deepening at the microlevel - we aggregate our estimates to provide an estimate of Scharfstein's (2018) capital-market deepening at the macrolevel. Our calculation suggests that for every additional USD that pension funds invest in stock markets, individual pension fund members privately invest four additional cents in stocks in their non-pension portfolio. This means that a microeconometric-based estimate of pensions' funds capital market deepening is 4%. We also show how this estimate vary with investor characteristics, finding larger capital market deepening for investors with higher liquid wealth.

The identifying assumption in our matching approach is that conditioning on lagged outcomes and other observable characteristics accounts for confounding unobservables, such as risk preferences and other investor traits. To assess the robustness of this assumption, we present analyses based on alternative identifications.

First, we estimate difference-in-differences models, which rely on the alternative identifying assumption that the treatment and control groups would have continued to follow parallel trends in the absence of the pension reform. Second, we redefine treatment as membership in the pension fund at the time of the product change, such that treatment captures exposure to the opportunity to invest in a riskier pension product, regardless of whether an individual actively chose to switch. This analysis also highlights the richness of our data, as it allows us to use the full Danish adult population as a control group. Because exposure is determined by pension fund administrators rather than by individual choice, concerns about endogeneity are arguably less pronounced in this setting. Across both alternative specifications, we find that stock market participation increases following the introduction of the option to switch pension products.

We also directly address a number of alternative explanations. One could be that pension fund members who changed pension products are less risk averse. Upon closer examination, this explanation is unlikely to explain our results. This is because we restrict (in the matching procedure) both the treatment and control groups to individuals who had not participated in the stock market before the opportunity to change pension products. There is no compelling reason to believe that less risk-averse individuals would delay stock market participation until precisely that moment in time when they were offered the option to switch pension products. A second alternative explanation could be that those who changed pension products are more active than those who do not. To address this, we exploit the fact that some people changed pension products in 2011, while others delayed their change to 2012 (a possibility offered by the pension fund). In contrast to activeness driving our results, we find no difference in stock market entry rates between the two entry groups. Third, we present evidence of peer effects. If our findings are indeed driven by a reduction in non-monetary participation costs—due to learning about stock markets through exposure to them in pension savings—the affected pension fund member might reasonably be expected to share this knowledge with their adult household members (predominantly their spouse). The family member is thereby informationally exposed without having changed their own pension product. Our results reveal consistent positive peer effects on stock market entry, where the impact is intuitively slightly smaller in magnitude. Fourth, even when changing the control group to a matched sample of individuals from the general population who are not members of the pension

fund—thereby neither being offered to change pension products nor having informational exposure—we get supporting results. Finally, we show that, within the overall population, individuals with riskier pension portfolios are also more likely to invest in stocks. Although we cannot establish causality for this sample of the general population, these results suggest that the positive relationship between risk-taking in pension and non-pension investments extends beyond the members of the specific large pension fund that we predominantly study.

Collectively, these and further auxiliary results on financial decisions show that when pension fund members are presented with an exogenous opportunity to switch to a high-equity pension product, those who choose to do so subsequently increase their equity investments outside the pension system.

Related literature

Scharfstein (2018)—who studies correlations between pension systems and the depth of capital markets—points out that establishing whether pension funds cause capital market deepening is challenging.[1] Using a pension reform in Denmark, our paper addresses this challenge using detailed registry-based household microdata with difference-in-differences estimations on matched samples.

Parker et al. (2025) examine how the passage of the Pension Protection Act (PPA) in the US in 2006—which allowed the use of Target Date Funds (TDFs) as the default option—impacted individuals' asset allocation over the life cycle. Using account-level data from a large financial services company, they show that younger investors increased their exposure to equities in non-retirement accounts following the introduction of the PPA, while older investors reduced their exposure—patterns consistent with TDF strategies. Our contribution is to investigate the impact of increased equity exposure in pension plans across the age distribution, similar to what is observed in shifts from DB to DC plans, and to investigate the macroeconomic effects.

Smirnova (2024) investigates how enrollment into Defined Contribution plans affects non-retirement equity exposure using Swedish data. While some of our and Smirnova's (2024) findings align, our setting allows for a more direct analysis of the link between pension plan equity exposure and household non-retirement investments. This is because our data reveal how much individuals are exposed to the stock market in their pension plan, and it is a change in this exposure that we utilize in our analyses. Also, the treated individuals in Smirnova

[1] Scharfstein (2018), pp. 1466–67, writes: "I want to be clear from the outset that my empirical approach is a simple cross-country analysis; I do not have instruments that would allow me to isolate exogenous variation in pension structure, nor do I study significant changes in policy that might enable me to conduct a difference-in-differences analysis".

(2024) are young adults (aged 18–34) with little wealth. Our study encompasses the full age distribution, which is important because older individuals typically hold greater wealth and thus play a more substantial role in equity markets and in quantifying the associated capital market effect.

Other papers have demonstrated correlation between equity exposure in pension plans and outside those plans. Weisbenner (2002) shows that households with DC pension plans allowing equity choices are 10-15 percentage points more likely to hold stocks in non-pension accounts, a pattern attributed to "learning-by-doing". Dahlquist, Setty and Vestman (2018) find a positive correlation between actively made asset allocation decisions in pension and non-pension stock market participation, which is consistent with the findings of Karlsson, Massa and Simonov (2007). Christelis, Georgarakos and Haliassos (2011) also find that if people hold retirement accounts they are more likely to hold equities in non-pension savings. Our study contributes to this literature by examining the causal impact of and increase in the financial risk of pension accounts on households' risk behaviour in their non-pension savings as well as to provide a microeconometric-based estimate of the macroeconomic magnitude of this effect.

Our study also relates to the public finance literature that focuses on estimating the impact of increases in pension savings on other savings. This goes back to Cagan (1965), who showed that increases in pension wealth do not offset other savings. In recent years, studies suggest that an increase in pension savings offsets other savings, even if this offset is well below 100% and depends on the setting (Attanasio and Rohwedder, 2003; Engelhardt and Kumar, 2011; Alessie, Angelini and van Santen, 2013; Chetty et al., 2014; Choukhmane and Parker, 2024; Choukhmane, 2025). We contribute to this literature by examining the effects of increasing the risk of pension savings (as opposed to the level thereof) on non-pension investments.

After these introductory remarks, our paper continues as follows. The next section presents our model, which shows how the choice of pension products can affect the choice of equity market investments in non-pension savings. Section 2 then presents the data and institutional framework, including a brief description of the Danish pension system and the pension fund we analyse. Next, Section 3 explains the empirical strategy (matching approach), while Section 4 presents the results of our tests before the final Section concludes.

1 Pension products and stock market entry: Theory

Standard portfolio theory predicts that individuals adjust their non-pension savings to offset changes in pension risk, aiming to preserve their overall optimal portfolio (see, e.g., Mayers and Smith (1983); Abel (2001)). In this section, we put forth an alternative hypothesis, namely that a pension product change can reduce barriers to stock market entry in non-pension savings, causing households' stock market exposure to increase in both pension and non-pension savings. To capture this idea, we present a simple two-period model that illustrates the positive effect of changing pension products on entering the stock market in non-pension savings.

The model conceptualizes an individual's life cycle as consisting of two distinct phases: the working phase and retirement. Investors start with exogenous wealth and face no additional income during the working phase nor during retirement. They optimally choose savings to smooth consumption over both phases. These savings, accrued during the working period, become their financial resource for retirement and can earn an interest return.

An investor, denoted by i, begins with an initial wealth of W_i at time $t = 1$. The investor makes three decisions during the working phase. The first decision is the level of savings, A_i, which determines the financial resources available in retirement. The second decision is whether to change to a high equity exposure pension product, a binary choice denoted by $P \in \{0, 1\}$. If $P = 1$, the investor changes pension products and incurs a pecuniary cost $x_{i,P}$, but benefits from a return on these savings during the retirement phase. The third decision is whether to enter the stock market during the working phase, represented by $S \in \{0, 1\}$. Choosing to enter the stock market ($S = 1$) also involves a cost $x_{i,S}$, but provides a return on wealth in the working period. Finally, the return to both the high equity pension product and the non-pension stock market is modelled as log-normal, thus allowing for risk. Formally, assume that: $\log(1 + r_P) \sim \mathcal{N}\left(\mu_P - \frac{\sigma_P^2}{2}, \sigma_P^2\right)$ and that $\log(1 + r_S) \sim \mathcal{N}\left(\mu_S - \frac{\sigma_S^2}{2}, \sigma_S^2\right)$. [2] Notice that with this parameter specification, the expectation of $(1 + r_X)$ and $\log(1 + r_X)$ for $X \in \{P, S\}$ equals:

$$\mathbb{E}(1 + r_X) = \exp\left(\left[\mu_X - \frac{\sigma_X^2}{2}\right] + \frac{\sigma_X^2}{2}\right) = \exp(\mu_X) \tag{1}$$

$$\mathbb{E}(\log(1 + r_X)) = \mu_X - \frac{\sigma_X^2}{2} \tag{2}$$

Hence, according to Equation (1), an increase in σ_X is a pure increase in risk, as it does not

[2] The two returns may be correlated. Because we use only the expectation of the log return in Equations (3) and (4) below, the correlation does not affect the results.

affect the mean return.

There is complementarity between changing pension products and entering the stock market. Changing to a high equity exposure pension product ($P = 1$) reduces the cost of entering the stock market (S) by a fraction of ξ, thus incentivizing both actions when economically viable.[3] Notice that complementarity is asymmetric: while the cost of entering the stock market decreases upon changing the pension products, the reverse does not hold. This captures the sequence of events that we will investigate empirically, where the change in the pension product precedes the decision of entering the stock market.

Investors aim to maximize their discounted lifetime utility, which is modeled as logarithmic in periodic consumption. In detail, investors choose a sequence of consumption $\{C_{i,t}\}_{t=1}^{2}$, savings A_i, and financial decisions $\{P, S\}$ to solve the following optimization problem:

$$\begin{aligned} \max_{\{C_{i,t}\}_{t=1}^{2}, A_i, P, S} \quad & \mathbb{E}\left(\log(C_{i,1}) + \log(C_{i,2})\right) \\ \text{s.t.} \quad & C_{i,1} = \left(W_i - A_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_S(1 - \xi\mathbb{1}_P)\right)(1 + r_S\mathbb{1}_S), \\ & C_{i,2} = A_i(1 + r_P\mathbb{1}_P), \end{aligned} \tag{3}$$

where $\mathbb{1}_P$ and $\mathbb{1}_S$ are indicator functions that equal 1 if the decision is $P = 1$ or $S = 1$, respectively, and 0 otherwise.

Before discussing the solution of the model, we discuss some of the modelling choices, including some of the simplifying assumptions, as this is a stylized model. First, we use one account rather than splitting the investor's resources between liquid financial wealth and illiquid pension wealth.[4] This assumption significantly simplifies the analysis while capturing the investor's ability to smooth consumption over the two periods using the aggregate resources. Second, we assume that complementarity is asymmetric. As mentioned, this is done deliberately to make the model consistent with our empirical analysis, where the pension product choice precedes the choice to enter the stock market. Third, we make two simplifying assumptions regarding parameters. Specifically, we normalize the return in the low equity pension product and without stock market participation to zero, and we do not allow for discounting utility across the periods. Those assumptions deliver a simple model that captures the positive effect of exposure to equity in the pension fund on stock market

[3] We follow Scharfstein (2018) here and argue that more stock market exposure by pension funds lowers the barriers to stock market entry for non-pension savings. This is different from Abel (2001), who argues that households have less incentive to pay the fixed costs of entering the stock market if their pension fund increases its equity exposure.

[4] This can be seen in the first constraint in maximization problem (3), which includes a return from stock market entry versus the second constraint, which includes a return from the pension fund.

participation through reduced barriers to entry.

In addition to those assumptions, our modelling of a single working period means that the reduced barriers to entry are internalized already in the first period, and that there is only one possible level of reduced barriers. Appendix A develops an extended four-period model to address those two limitations. Using that model, we show that entering the stock market in the first period is not immediately associated with a reduced participation cost but is delayed to the later periods. This is consistent with the empirical analysis, where participation differences are examined one year after the pension change took place, and reflects the time it takes for barriers to be reduced, e.g. through familiarity with the pension product and its consequences. Second, we use the second and third periods to demonstrate a gradual decrease in the cost of barriers to entry, leading to a gradual increase in entry. This feature is again consistent with our empirical analysis.

1.1 Optimal consumption allocation

Optimal savings and consumption levels, conditional on the two financial decisions, are:

$$\begin{aligned}
A_i &= \tfrac{1}{2}\big(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_S(1-\xi\mathbb{1}_P)\big),\\
C_{i,1} &= \tfrac{1}{2}\big(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_S(1-\xi\mathbb{1}_P)\big)(1+r_S\mathbb{1}_S),\\
C_{i,2} &= \tfrac{1}{2}\big(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_S(1-\xi\mathbb{1}_P)\big)(1+r_P\mathbb{1}_P).
\end{aligned}$$

Given this optimal solution, the optimal value can be written as:

$$U = 2\log(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_S(1-\xi\mathbb{1}_P)) + \mathbb{1}_S\Big(\mu_S - \tfrac{\sigma_S^2}{2}\Big) + \mathbb{1}_P\Big(\mu_P - \tfrac{\sigma_P^2}{2}\Big) - \log(4).$$

This term encompasses four values, depending on combinations of the two financial choices P or S:

$$U = \begin{cases}
2\log(W_i) & P=0,\ S=0,\\
2\log(W_i - x_{i,P}) + \mu_P - \frac{\sigma_P^2}{2} & P=1,\ S=0,\\
2\log(W_i - x_{i,S}) + \mu_S - \frac{\sigma_S^2}{2} & P=0,\ S=1,\\
2\log(W_i - x_{i,P} - x_{i,S}(1-\xi)) + \mu_P - \frac{\sigma_P^2}{2} + \mu_S - \frac{\sigma_S^2}{2} & P=1,\ S=1.
\end{cases} \tag{4}$$

where the constant term $-\log(4)$ was omitted from all options.

1.2 Optimal financial decisions

Based on the values in system (4), we represent the two financial decisions in a plot that emphasizes the importance of reduced barriers to stock market entry. Figure 1 uses a two-dimensional cost structure, with the cost of changing pension products on the horizontal axis and the cost of entering the stock market on the vertical axis. Both costs are represented as a fraction of initial wealth, W_i. The two panels describe the optimal combinations of the two decisions (pension product change and stock market entry). The top panel does not allow for reduced participation costs ($\xi = 0$), whereas the bottom panel depicts the same decisions if barriers to entry can be reduced at $\xi = 25\%$ (i.e., upon changing the pension products, entry becomes 25% less costly). The cost of changing pension products and the cost of entering the stock market range between $[0\%, 4\%]$ of initial income.[5] Finally, each of the returns is set to 6%, with a standard deviation of 18%.

Figure 1, panel A, includes four distinct regions. In the region labelled *Both* (bottom left corner), the costs are low for both a change in pension products and stock market entry. In this region, the investor changes the pension products and enters the stock market. The region labelled *High-equity Pension* (top left) reflects a higher stock market entry cost; the investor changes the pension products but does not enter the stock market. The region labelled *Neither* (top right) corresponds to high costs for both actions, resulting in neither a change in pension products nor stock market entry. Finally, the region labelled *Stock Market Entry* (bottom right) reflects lower entry costs but higher pension switching costs, and the investor chooses to enter the stock market without changing the pension product.[6]

Turning to Figure 1, panel B, the complementarity between the two financial decisions expands the *Both* region, where the investor both changes the pension products and enters the stock market. Formally, using comparative statics, we show that conditional on changing the pension products, stock market entry increases with complementarity between the two financial decisions.[7] In addition, for intermediate costs of changing the pension products (at

[5] The low costs of financial decisions are consistent with most of the literature on participation costs, which estimates them at a few percentage points of annual income. See Vissing-Jørgensen (2002), Alan (2006), and Khorunzhina (2013) for details. A notable exception is Haliassos and Michaelides (2003), who obtain a wide range for entry costs, from 3% to 34% of mean annual income, depending on model parameters.

[6] The *Both* region in panel A slopes slightly, which is caused by the effect of marginal utility. For example, given a change in the pension product, an increase in the cost of entering the stock market implies that choosing stock market entry lowers wealth and consumption, therefore increasing the marginal utility of consumption. The increased utility cost of entry implies a slight decrease in stock market participation.

[7] To see this, differentiate the difference in values between entry and non-entry, conditional on changing the pension products: $\frac{\partial(2\log(W_i - x_{i,S}(1-\xi) - x_{i,P}) + \log(1+r_S) - 2\log(W_i - x_{i,S}) + \log(1+r_S) - 2\log(W_i))}{\partial \xi} = \frac{2x_{i,S}}{W_i - x_{i,S}(1-\xi) - x_{i,P}}$, and conditional on not changing the pension products: $\frac{\partial(2\log(W_i - x_{i,S}) + \log(1+r_S) - 2\log(W_i))}{\partial \xi}$ Note that both terms are non-negative.

a little more than 2% of wealth in panel B), an increase in the cost of entering the stock market (moving "up" in the panel) induces more rather than less participation, as investors move from *Stock Market Entry* to *Both*. The economic force here is that an increase in the stock market entry cost encourages the investor to change pension products to enjoy the complementarity benefit that reduces the entry cost.

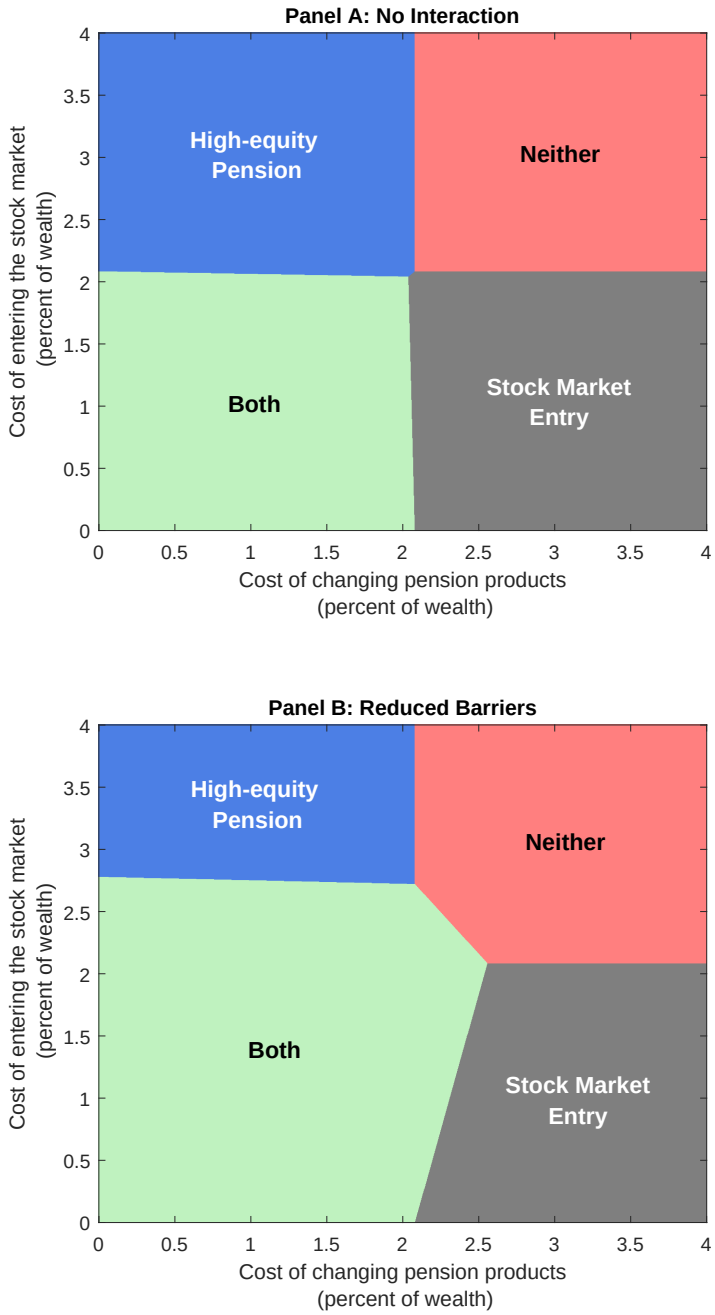
1.3 Other supportive theories

The model presented here is similar in spirit to Scharfstein's (2018) model, albeit ours focuses on microeconomic individual financial choices rather than macroeconomic general equilibrium effects of pension funds. Assuming a fixed cost for households to participate in the stock market, as we do, Scharfstein's model predicts that countries with larger privately funded pension systems will have more developed capital markets than countries relying on pay-as-you-go pension systems, where the latter tends to have less equity exposure. Additionally, if pension funds familiarize people with the risky products they can invest in, the cost of participation might decrease over time (in our model, this happens through the parameter ξ), lowering the threshold to invest in stocks (Scharfstein, 2018). This pulls more households into the stock market, leading to further divergences between capital markets of countries with privately funded vs pay-as-you-go systems, a phenomenon Scharfstein (2018) names capital market deepening.

Other theories of individual behaviour could make equivalent predictions, all of which could be incorporated into our model. In the period we study, the high equity product persistently earn higher returns than the low equity product (see Section 3), and these positive return experiences could increase the expectations of equity returns for individuals, as Malmendier and Nagel (2011) and Huang (2019) demonstrate. As Kaustia and Knüpfer (2008) underscore, personally experiencing high returns in one's own investments matters more than simply living through times of high returns. Therefore, as only those who changed products felt the effect of the returns on their pension wealth, the high returns should affect their return expectations more, making them more likely to enter the stock market using their non-pension savings.[8] Alternatively, volatility was low during this period, which could reduce expected volatility, resulting in the same effect. Our model can easily accommodate this by having the change of pension product increase the expected return in non-pension

[8]One might reasonably wonder if pension fund members are aware of the fund's returns. However, the fund provides an online service that allows members to follow returns and observe increases in their pension wealth. In addition, the fund sends quarterly magazines and emails reporting on the fund's performance, where 90% of members report reading it occasionally, while 50% report reading or skimming it every time (JØP, 2016).

Figure 1: Optimal financial choices in the two-period model



Notes: This figure illustrates the optimal financial choices over a horizontal grid of the cost of changing pension products and the vertical axis of the cost of entering the stock market. In this example, the premium return on each action is 6%, with a standard deviation of 18%, and the range of the costs is [0%,4%] of initial wealth, W. Panel A shows the optimal choices without reduced barriers. Panel B shows the choices given a 25% reduction in the cost of entry for an investor who changes pension products.

stock market participation, (r_S), or reduce the perceived volatility, (σ_S^2), which has a similar effect as the reduction in the cost of entry. These theories make equivalent predictions and cannot be distinguished using the data at hand. However, they all consistently suggest that the change to the high equity exposure pension product could increase individuals' familiarity with the stock market, leading to further equity market investments using their non-retirement wealth.

2 Data and institutional setting

2.1 The Danish pension system

We explore our model's prediction of a positive relationship between stock market exposure in pension and non-pension savings using a Danish pension fund that suddenly allowed its members to change pension products in 2011–2012. To facilitate an understanding of the setting, we provide a brief introduction to the Danish pension system (see Andersen, Jensen and Rangvid, 2022, for more details), followed by a description of the specific pension fund.

The Danish pension system often ranks among the world's "best" (Mercer and CFA-Institute, 2024) and, relative to GDP, Danish pension savings are among the highest in the world. The system is based on a three-pillar model, i.e. public pensions, occupational pensions, and private savings. There is widespread adoption of occupational pensions, which make up the second pillar. The second pillar pension funds in Denmark—which include the one we study—generally offer two types of products: a low equity ("guaranteed") product and a high equity ("market-sensitive") product. The former usually promises a life annuity based on a guaranteed minimum rate of returns that is fixed for life (Jarner, Munk and Steffensen, 2022). This rate is based on the prevailing interest rate at the inception of the contract and cannot change, although the realized return on the product can naturally exceed the guaranteed rate if the underlying investments perform well. Hence, for this product, the individual member faces a relatively low degree of financial risk. On the other hand, a high equity product is riskier, with a higher expected return, and either lacks a guaranteed rate, features a guarantee that is conditional on funding status, or offers a guaranteed rate of 0% (Balter, Kallestrup-Lamb and Rangvid, 2021; Jarner, Munk and Steffensen, 2022).

2.2 The pension fund

We have access to a unique dataset with information on financial records of members of Juristernes og Økonomernes Pensionskasse (JØP), which is the pension fund for lawyers and

economists in Denmark (in 2019, JØP changed name to its current name P+).[9] Prior to 2005, all members of JØP were offered a guaranteed rate product with a rate determined at the inception of the contract and based on the prevailing interest rate of the time. The guaranteed rate exhibited a declining trend in tandem with the decrease in interest rates, from 4.25% (prior to 1990) to 2% (from 1999 to 2005), cf. Appendix B, Table B.1. Members who joined JØP after 2005 were only offered a high equity product with a guaranteed rate of 0%.

Low interest rates, unexpected increases in life expectancy, and Solvency II regulations prompted JØP to inform members that their guaranteed product savings would primarily be invested in safe assets with return protections and that bonus payments beyond the guaranteed rate were unlikely. Therefore, in 2011, members were offered the option to change to the market-sensitive product, which entailed a reduction of the guaranteed rate to 0%.[10] This option was then again offered in 2012, to allow stragglers a second chance to change products. Seen from the individual member's point of view, the possibility to change pension products represented an exogenous opportunity to increase the risk—and potential returns—in their risk pension savings. The resulting variation in pension risk serves as the identifying variation in our analysis.

The switch to a high equity pension product would allow JØP to invest more freely in assets such as stocks and riskier bonds with the aim of achieving higher returns. Members were then shown projections of their expected life annuity payments based on their guaranteed rate, which, while subject to changes due to shifts in life expectancy, could not fall below a minimum level (Balter, Kallestrup-Lamb and Rangvid, 2021). Although this switch entailed a greater financial risk, members were advised that this was expected to result in larger pension payments upon retirement. This therefore does not generate any confounding wealth effects. Members were informed of these changes via a letter and on the website where they could make the switch.[11] The website also provided background information and displayed projected pension payments for both options, demonstrating that the market-sensitive product was expected to yield larger pension payments. Appendix C contains the aforementioned letter and website screenshots.

[9] In Section 5.5 we broaden the sample to study the pension wealth of all members of any Danish pension fund. This comes at the cost of being confined to study only the *correlation* between risk in pension savings and non-pension stock market participation. The results are consistent with those of the main analysis.

[10] This involved a sale of the return protections guaranteeing their returns. The proceeds of this sale were transferred to members pension accounts. However, this was a zero net present value transaction, wherein the members received the fair value for their guarantees upon losing said guarantees, and thus no real increase in pension wealth took place.

[11] Letters were sent out simultaneously, not staggered, to all members.

Table 1, which shows the asset allocation of the two products from 2012 to 2017, indicates that changing products involved a significant increase in financial risk. In the first year of the product's existence, 16% was invested in equities, compared to 0% in equities the guaranteed product. Over time, this increased to an allocation as high as 43.2% in equities in 2016, whereas the guaranteed product remained at around 90% safe bonds and 10% real assets (e.g. infrastructure, real estate, and private equity) throughout the entire period. In addition to a larger equity share, a larger fraction was invested in real assets and corporate bonds in the high equity product. The last column in Table 1 shows that this higher risk was rewarded with good returns for high-equity products, where in all but one year, the return of the high-equity product was higher than the maximum attainable guaranteed rate.[12] At the same time, the returns are not exceptionally high. As the market risk premium is positive in the long run, i.e. people can expect positive long-run risk compensation if choosing high-equity exposure, we are fortunate to study a period representing such a positive market risk premium.

2.3 Data and summary statistics

In 2011, when members of JØP were offered the opportunity to change pension products, 21,888 members held a low equity product. We observe individuals' guaranteed rate, whether they changed products, and the level of wealth invested with JØP before and after the product change. We link everyone in the sample to detailed registry data from Statistics Denmark, enabling us to examine the relationship between the risky asset allocation in pensions and the allocation of non-pension wealth. The data on non-pension investments are very granular, including information on the amount individuals invested in each stock and mutual fund held, along with information on the type of mutual fund, equity, or fixed income fund.[13] The pension fund data from JØP only extend back to January 2011 but we also have registry data from Statistics Denmark on the individuals in the sample dating back to 2004, the earliest year in which all members with a guaranteed product in the sample were enrolled in JØP (had they joined after 2004, they would not have a guaranteed product). We end our sample in 2017 because we do not have granular data on non-pension investments after this year. The registry data from Statistics Denmark are recorded annually at the

[12] In our sample, the average guaranteed rate received was 3.4%. Roughly a third received the maximum rate of 4.25%, a third 3.70%, and a third 2% or 3%.

[13] The information on whether a fund is a fixed-income fund is missing after 2012. We classify funds after this year by using their classification from before 2012. If they do not appear before 2012, we classify them as bond funds if they have bond-related terms in the name. The text-based approach has a 90% accuracy before 2012, so overall we also expect this classification to be quite successful after 2012.

Table 1: Asset allocation and returns

Product	Year	Fraction of assets in: Government bonds	Corporate bonds	Equities	Real assets	Returns
Low equity exposure (Guaranteed)	2012	92.0%	0.0%	0.0%	8.0%	2.0% – 4.25%
	2013	91.1%	0.0%	0.0%	8.9%	2.0% – 4.25%
	2014	90.0%	0.0%	0.0%	10.0%	2.0% – 4.25%
	2015	90.0%	0.0%	0.0%	10.0%	2.0% – 4.25%
	2016	90.0%	0.0%	0.0%	10.0%	2.0% – 4.25%
	2017	90.0%	0.0%	0.0%	10.0%	2.0% – 4.25%
High equity exposure (Market-sensitive)	2012	72.7%	0.0%	16.4%	10.9%	6.10%
	2013	56.4%	5.8%	30.1%	7.7%	4.90%
	2014	46.1%	8.1%	32.3%	13.5%	7.00%
	2015	29.8%	13.2%	43.2%	13.8%	4.10%
	2016	25.6%	16.3%	43.2%	14.9%	6.60%
	2017	35.9%	15.8%	34.4%	13.8%	9.10%

Notes: This table shows the asset allocation employed by JØP at the end of the year for the guaranteed product and the market-sensitive product from 2012 to 2017. After 2013, the actual investment policy of the guaranteed product is not available, so we use the benchmark investment. The information presented is from JØP's annual reports 2012 to 2017. For the market-sensitive product we display the return JØP made on the investments of the members with a market-sensitive product, and for the guaranteed product, we display the range of the guaranteed returns members could receive (where the specific guaranteed rate depends on the year a member joined).

end of each year.[14] To ensure that changing sample composition does not influence our results, we have limited our analysis to a balanced sample, i.e. we analyse individuals who are members of JØP and have no missing data from Statistics Denmark every year from 2004 to 2017. The final sample consists of 17,825 individuals and 249,550 individual-year observations, covering 2004 to 2017.

Table 2 presents the descriptive statistics for the individuals in our final sample, as of 2010, which is the year prior to the product change. The summary statistics are stratified based on the individuals' decision to change or keep their low equity pension product. A substantial proportion of members (80%) changed products, which can be attributed to JØP prompting them to make a decision, giving them two opportunities to do so, and providing substantial informational materials.[15]

[14] As the pension fund data is monthly, we only keep the last pension fund observation each year. To approximate the wealth invested in the fund in December 2010, we subtract the contribution paid in January 2011 from the wealth invested.

[15] This might appear large compared to the 15% active savers who reacted to a change in the tax code in 1999 that reduced the rate at which pension contributions could be deducted from taxable income, as

The summary statistics reveal differences in characteristics between the individuals who changed products and those who kept their guaranteed product. The individuals who remained with their guaranteed product exhibit a lower stock market participation rate (7 percentage points lower), but this we control for by restricting our analysis to those with the same stock market participation status prior to receiving the offer to change pension products (cf. Section 3). Surprisingly, Table 2 reveals that those changing to the high-equity product are both older and have a higher guaranteed rate. However, these raw differences are influenced by high correlation with pension wealth. Once we control for pension wealth, a regression on the probability of changing products reveals that age has no significant effect and this probability is decreasing with the guaranteed rate, as one would expect.[16]

Given these differences, it is important to control for background characteristics across the two samples in our analyses. We accordingly next turn to our empirical matching strategy that ensures that there are no observable differences across the individuals we empirically compare across the two groups. On top of that, in Section 5 we also present both alternative treatment groups (individuals not offered to change pension products, but still informationally exposed via family members receiving the offer) and alternative control groups (members of other pension funds that are not offered the change in pension products). Along with further robustness checks in Section 5 that address non-observables characteristics (e.g., risk aversion and activeness), these measures collectively support both the identifying assumption and the underlying informational mechanism.

3 Empirical strategy

The primary objective of our empirical analysis is to compare the stock market participation (outside pension savings) of individuals who changed pension with the participation rates of individuals who kept their low equity exposure product. For identification, the differences in observable characteristics must be controlled for. Also, as the two groups could differ in terms of unmeasured factors that could have impacted their decision to change products, we can leverage the longitudinal nature of our data to also condition on prior outcomes to mitigate the effects of such potential confounding unobservables. We are thus conditioning on prior investment behaviour as well as variables such as age, gender, unemployment insurance

documented in Chetty et al. (2014).

[16] Appendix B, Table B.2 presents the results of a multivariate probit regression showing the average partial effects of these three variables, along with other variables of interest on the probability of changing products. In short, those who change products are likely to be wealthier (more pension wealth, own stocks and be a homeowner), be males and have a relatively low guaranteed rate).

Table 2: Summary statistics

	Kept low equity exposure			Changed to high equity exposure		
Numerical variables	Mean	Std	Median	Mean	Std	Median
Wealth in equities (DKK)	76,825.94	326,339.24	0.00	111,954.30	373,484.56	0.00
Share of financial wealth in equities	11.45%	24.04%	0.00%	13.90%	24.98%	0.00%
Number of stocks	0.85	2.43	0.00	1.17	2.86	0.00
JØP pension wealth (DKK)	655,991.71	702,875.69	493,857.10	1,265,261.95	927,574.95	996,990.80
Guaranteed rate	3.07%	0.91%	3.00%	3.48%	0.87%	3.70%
Age	45.76	10.30	43.00	49.85	10.57	49.00
Non-equity financial wealth (DKK)	300,387.86	648,479.69	79,892.30	344,161.70	644,217.25	115,313.70
Housing wealth (DKK)	1,380,322.63	1,525,033.75	1,100,000.00	1,546,521.35	1,486,496.47	1,250,000.00
Total liabilities (DKK)	1,109,415.47	1,167,319.02	911,031.80	1,060,210.72	1,084,142.86	872,598.10
Disposable income (DKK)	331,430.74	208,039.21	298,025.15	351,927.17	178,768.95	317,203.20
Work experience (years)	14.66	7.01	13.60	19.14	7.75	18.73
Lifetime unemployment (years)	1.22	2.18	0.34	0.72	1.40	0.16
Categorical variables	**Fractions**			**Fractions**		
Stock market participation	36.54%			43.74%		
Direct stockholding only	25.61%			27.17%		
Indirect stockholding only	3.37%			4.48%		
Both direct and indirect	7.56%			12.09%		
Female	50.33%			43.77%		
Highest education: Business or economics	31.59%			28.73%		
Highest education: Other social science	57.62%			61.48%		
Highest education: STEM	4.59%			4.20%		
Highest education: Other higher education	2.67%			1.75%		
Employed	81.50%			85.07%		
Self-employed	5.74%			3.49%		
Retired	8.02%			8.99%		
Homeowner	73.94%			82.17%		
Unemployment insurance	74.76%			74.63%		
Has spouse	64.58%			72.63%		
Separated	11.51%			10.76%		
Capital region	60.66%			59.77%		
No. of individuals	3,292			14,533		
No. of individual-year observations	46,088			203,462		

Notes: This table shows the mean, median, and standard deviation for relevant variables but also presents an overview of the distribution of our sample. The numbers are from 2010, the year before the product change. We present these statistics separately for those who changed from low to high equity exposure products, and those who kept their low equity exposure products. All DKK variables are winsorized within each year at the 1st and 99th percentiles, and are inflation adjusted to December 2010 DKK. All medians reported are the means of the 10 observations closest to the median.

uptake, etc. that we detail below. In the context of the theoretical model, this is equivalent to saying that, conditional on observable characteristics and prior investment behaviour, the distribution of stock market entry costs does not depend on the pension fund choice. Also, in Section 5 we further address alternative explanations based on unobserved characteristics.

To effectively account for prior outcomes and other relevant covariates, we employ a matching approach to compare individuals in 2010, the year prior to the product change being offered for the first time.[17] We implement a two-step matching strategy, first by dividing the sample

[17] As previously mentioned, the opportunity to change products was only extended to individuals holding

into two groups based on stock market participation in all years between 2004 and 2010 (those who participated in all those years and those who never did). This period is chosen, as 2004 is the earliest year in which we can be certain everyone in our sample are members of JØP. Within these two groups, we conduct a 1:1 match with replacement, using the covariate balancing propensity score (Imai and Ratkovic, 2014), between individuals who changed products and those who did not. The propensity scores are estimated using individual-level data from Statistics Denmark, using 2010 values of the following individual characteristics: age, gender, region of residence, educational field, civil status, disposable income, non-equity financial wealth, debt, JØP pension wealth, level of guaranteed rate, homeownership status, value of home, number of children living at home, work experience, attachment to the labour market, time spent unemployed during their lifetime, time spent unemployed during 2010, and unemployment insurance status.[18] Additionally, for those participating in the stock market prior to 2010, we also include equity wealth, share of financial wealth in equities, participation mode, share of financial wealth in equity mutual funds, share of financial wealth in stocks, and the number of directly held stocks. To ensure common support, we drop observations with propensity scores higher than the highest propensity score among controls (Dehejia and Wahba, 1999; Lechner and Strittmatter, 2019). This results in the removal of seven individuals among those not participating prior to the product change and 19 individuals among those participating prior to the product change.

Appendix D presents a detailed examination of the effectiveness of our two-step matching process employed to balance covariates between treatment and control groups. Based on the summary statistics shown in Table D.1 for the four resulting groups, and the covariate balance improvements shown in Figures D.1 and D.2, it can be concluded that the matching was effective in practically eliminating any differences in means and standard deviations between the two groups. Comparing treatment to control post-matching, the standardized mean differences of all covariates and the propensity score between the two groups are well

the low equity exposure product in both 2011 and 2012, with all recipients receiving the same informational material outlining the benefits of the riskier pension option. Therefore, all individuals who changed products in either 2011 or 2012 are considered treated in 2011, as the ones who changed products in 2012 could anticipate being offered a second product change and had been given the informational material about the benefits of a riskier pension in 2011.

[18]Some of these variables require additional explanation. Educational field can be one of the following: no higher education, economics or business education, other social science education, STEM education, or other higher education. Civil status can be one of the following: have a partner, never had a partner, or separated/widowed. Attachment to the labour market can be one of the following: employed, self-employed, retired, sick leave, unemployed, student, or outside the labour force. We group those who are on sick leave, unemployed, or studying together, as there are few individuals in each category. Unemployment insurance is a dummy variable taking on the value of 1 if an individual has chosen to be a paying member of an unemployment insurance fund, providing extra income coverage beyond baseline government unemployment benefits during unemployment spells.

within the bounds (-10% to 10%) proposed by Austin (2009).

In sum, we identify a comparable counterpart for each individual who changed pension products. The matching is based on the similarity in covariate values, with the additional constraint that the stock market participation status in the past seven years must be equal. As a result, four distinct groups emerge, as shown in Table 3.

Table 3: Matched groups

	Changed products	**Did not change products**
Did not participate in the stock market in any year: 2004–2010	Treatment group 1	Control group 1 – matched to make similar to treatment group 1
Participated in the stock market every year: 2004–2010	Treatment group 2	Control group 2 – matched to make similar to treatment group 2

Notes: This table shows the four groups that form the basis for our analysis. The four groups comprise those who changed from low to high equity exposure products and did not participate in the stock market prior to 2011 (treatment group 1), and those who kept their low equity exposure products and did not participate in the stock market prior to 2011 (control group 1), those who changed from low equity to high equity exposure products and participated in the stock market prior to 2011 (treatment group 2), and those who kept their low equity exposure products and participated in the stock market prior to 2011 (control group 2).

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Our subsequent analysis compares the mean of an outcome after the product change between individuals who changed and those who did not, conditional on prior stock market participation status. For example, when evaluating stock market participation, we differentiate between the effect on new entry into the stock market (comparison of treatment group 1 and control group 1) and continued participation (comparison of treatment group 2 and control group 2).

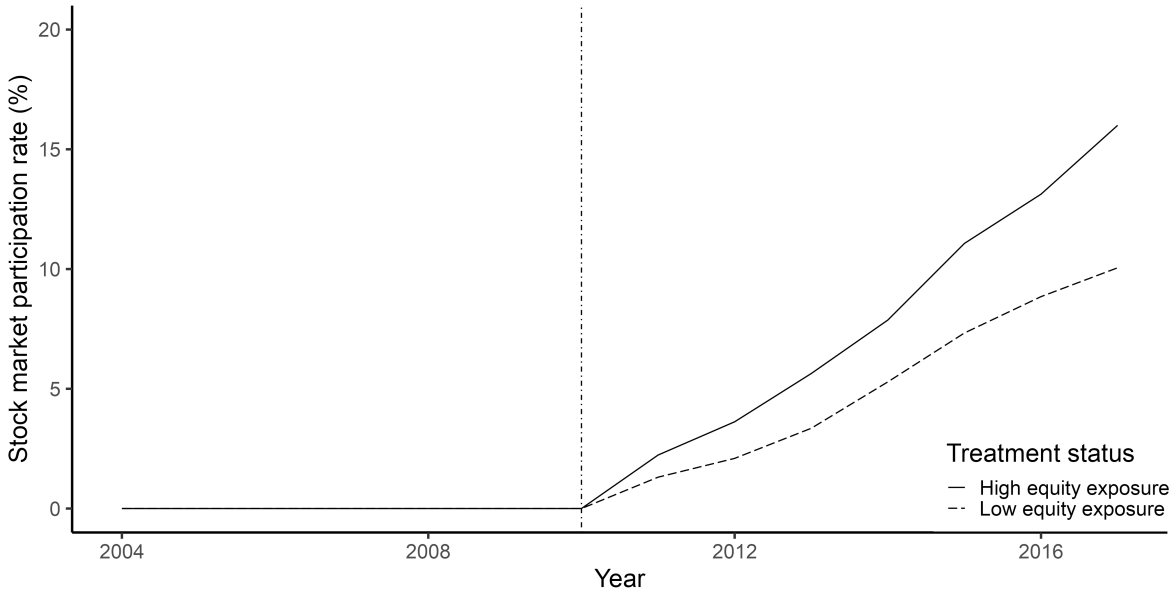
4 Results

4.1 Stock market participation

Figures 2 and 3 show the stock market participation rate for those who changed products vs those who did not. Figure 2 shows this for those who did not participate in any year prior to the product change, and Figure 3 for those who participated in every year prior to the

product change. Figure 2 shows our main result, which is that there is a large difference in the stock market entry rates of those who changed to the high equity product compared to those who did not. Continued participation in Figure 3, on the other hand, shows that this difference is much smaller and, as we will show, disappears entirely when appropriately controlling for other covariates. So, at first glance, there is a positive effect of the product change on stock market entry, and a much smaller effect on continued participation.

Figure 2: Stock market entry



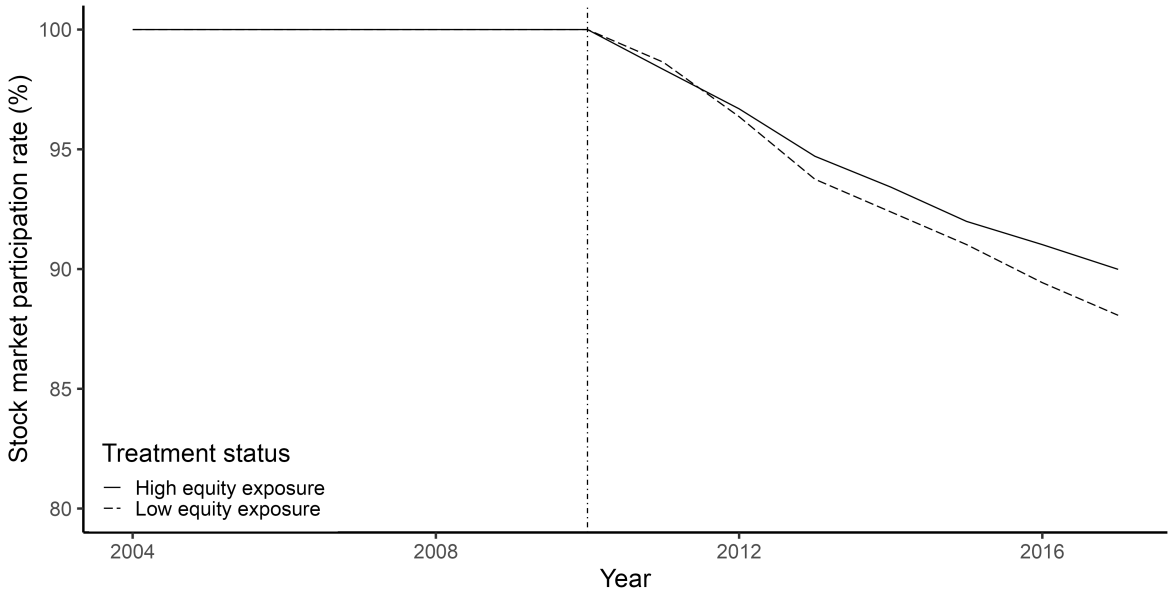
Notes: This figure shows stock market entry rates over time for those who changed from low to high equity exposure products, and those who kept their low equity exposure products. We focus on those who did not own stocks in the seven years leading up to the year of the product change.

We analyse the effects more rigorously in our matched samples. With regards to stock market participation, we run the following regressions to examine the differences between those who changed products and those who did not. First, to get a sense of the dynamics, we estimate the effect for 2017 only to analyse the cumulative effect, and then later for every year after the product change. The regression analysis is conducted separately for individuals who owned stocks prior to the product change and those who did not. The regression is:

$$StockMktPart_i = \alpha + \delta HighEquity_i + x_i\beta, \tag{5}$$

where $StockMktPart_i$ is a binary variable equal to 1 if an individual has non-pension wealth invested in equity in 2017, $HighEquity_i$ is a binary variable equal to 1 if an individual changed from the low equity exposure to the high equity exposure pension product and 0 otherwise,

Figure 3: Continued stock market participation



Notes: This figure shows continued stock market participation rates over time for those who changed from low to high equity exposure products, and those who kept their low equity exposure products. We focus on those who owned stocks in each of the seven years leading up to the year of the product change.

and x_i is a vector with the 2017 values of the control variables, to control for possible changes in these variables between the year of matching (2010) and 2017. As everyone has the same values of the outcome variable before the product change, this is equivalent to taking the difference in differences.

Table 4 presents the results of our regressions. Our findings reveal a significant impact on stock market participation. Among those who did not have prior investment in the stock market before 2011, those who changed from the low equity to the high equity exposure product were 6.9 percentage points more likely to participate in the stock market six years after the product change. This is a substantial increase, as it represents a 20% increase relative to the 35% stock market participation rate among those who retained the low equity exposure product.[19] Conversely, there is only a small and statistically insignificant difference observed among those who were already participating in the stock market prior to 2011. Thus, the increased pension risk appears to drive a substantial rise in the likelihood of participation in the stock market, while having no significant impact on continued participation.

The finding that individuals who changed pension products are more likely to participate

[19]The estimated effect also represents a 75% increase relative to the 9.5% stock market entry rate among those who retained the low equity exposure product, or the general population, where 8.9% of those not participating from 2004 to 2010 entered the stock market between 2010 and 2017.

Table 4: Stock market participation

	Entry			**Continuation**		
	(1)	(2)	(3)	(4)	(5)	(6)
High equity exposure	0.066***	0.069***	0.069***	-0.002	-0.003	-0.003
	(0.012)	(0.014)	(0.013)	(0.018)	(0.018)	(0.017)
Control variables	No	Yes	Yes	No	Yes	Yes
Logit	No	No	Yes	No	No	Yes
No. obs.	14,674	14,674	14,674	9,450	9,450	9,450
R^2 adj.	0.010	0.050	0.064	0.000	0.037	0.071

Notes: This table shows the regression results from the regression in Equation (5), estimating the 2017 difference in stock market participation between those who changed from low to high equity exposure products, and those who kept their low equity exposure products. The dependent variable is a dummy indicating whether an individual owns equities. The variable of interest, "High equity exposure", is a dummy variable indicating whether an individual changed from low to high equity exposure products. Columns 1–3 show the results for those who did not participate in the stock market prior to 2011, thus showing the effect on stock market entry. Columns 4–6 show the results for those who participated in the stock market prior to 2011, thus showing the effect on continued stock market participation. Columns 3 and 6 show the average partial effects from a logistic regression. The standard errors are clustered at the individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

in the stock market is consistent with our model. When there is no interaction between the two choices in the model, there is little difference between the fraction of those who participate in the stock market, irrespective of whether they change pension products or not (Figure 1, panel A). However, with reduced barriers to stock market entry following a product change, there is a significantly larger fraction of those who change products that also choose to enter the stock market (Figure 1, panel B). Our empirical results show exactly that, thus indicating that increased exposure to equity through pension holdings lowers the barriers to entering the stock market.[20]

Turning to the impact of changing pension products on continued participation, i.e. Table 4, columns (4)–(6), we observe that the (non) effect is consistent with our hypothesis regarding a reduction in barriers to entry, since those who have already entered are already familiar with the stock market. Having already paid the entry costs, these individuals should be indifferent to this reduction, and there should be no effect on continued participation. Consequently, this serves as a placebo test.

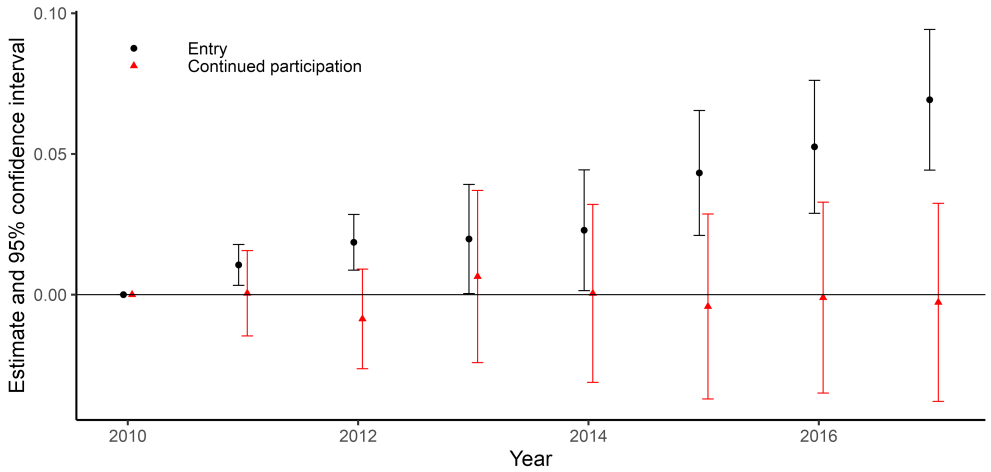
[20] When looking at entry, the regression in Equation 5 essentially estimates $\frac{Both}{Both+Changed\ Pension\ Products} - \frac{Stock\ Market\ Entry}{Neither+Stock\ Market\ Entry}$ in Figure 1 (the fractions are based on the regions).

4.2 Dynamic impact

Our model in Section 2 comprises two periods. In a multi-period extension (Appendix A), we explore the effects of a further intuitive reduction in the fixed costs of participation (an increase in ξ in our model), due to prolonged exposure to risky financial investments through the pension product, coupled with the receipt of performance-related information from the fund. The extended model suggests an immediate impact on stock market participation driven by an initial reduction in the fixed costs of participation upon receiving informational materials about the pension products and being required to make an active decision. Over time, participation rates diverge further between those who change products and those who do not. This divergence arises from an ongoing reduction in participation costs for those who change pension plans.

To empirically evaluate the dynamic impact of the change to a high equity exposure product, we repeat the cumulative analysis up to 2017 for every year after the product change, as depicted in Figure 4.

Figure 4: Stock market participation over time



Notes: This figure shows the regression results from the regression in Equation 5, estimating the difference in stock market participation between those who changed from low to high equity exposure products and those who kept their low equity exposure products every year after the product change. The dependent variable is a dummy indicating whether an individual owns equities. The variable of interest, "High equity exposure", is a dummy variable indicating whether an individual changed from the low to high equity exposure product. We include the point estimates and the 95% confidence interval. The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).

We find an immediate effect on entry, and a monotonically increasing impact over time, but no effect on those who already participated before the product change. Together with Table

1, which demonstrates that the share of risky assets in the high equity exposure product increases over time, these results reveal that risky asset allocation is increasing both within and outside of the pension fund every year following the product change in a general and gradual manner. This also means that if we had, for instance a year with negative returns, this would most likely not change the picture much, exactly because the dynamic effects seem independent across individual years.

We note that an alternative explanation to continuously decreasing participation costs, which could easily be incorporated into our extended model, is that individuals who changed to the high equity exposure product experienced a higher return on their pension wealth (Table 1), leading to a gradual increase in their expected returns, and thus gradually higher entry rates, which is similar to reduced participation costs (Malmendier and Nagel, 2011).

4.3 Alternative Identifications

4.3.1 Difference-in-differences

Our identification (matching) strategy relies on the assumption that conditioning on lagged outcomes (in particular, prior investment behavior) and other covariates accounts for confounding unobservables (Imbens and Wooldridge, 2009; Lechner, 2011). An advantage of this approach is that it allows us to distinguish between effects on stock market entry and effects on continued participation. This distinction is economically meaningful because existing participants provide a natural placebo group: if the product change primarily operated by lowering barriers to entry, then individuals already participating in the stock market should be comparatively unaffected. Nevertheless, to assess the robustness of our main findings, we additionally estimate a difference-in-differences specification.

It is important to emphasize that the difference-in-differences approach relies on a different identification assumption than the matching procedure. Specifically, the difference-in-differences (DID) research design procedure assumes that unobserved confounders are time-invariant, implying that, in the absence of the shock, the treatment and control groups would have continued to follow parallel trends. Thus, this analysis provides a robustness check based on an alternative identifying assumption.

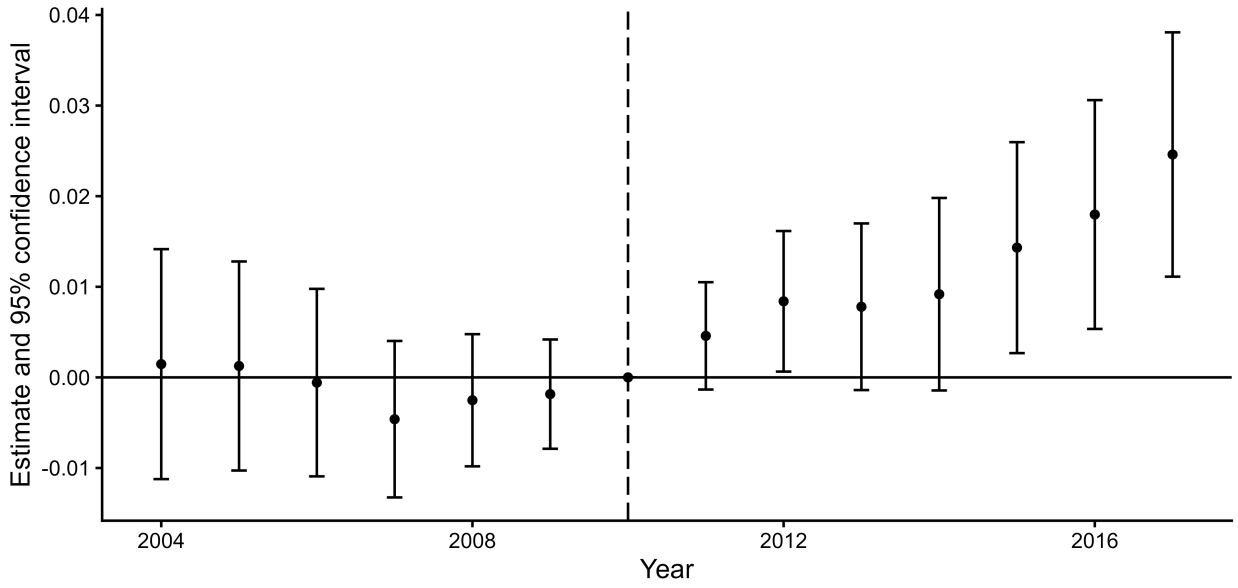
In this exercise, we dispense with the matched sample and instead use the full sample of pension fund members. Figure B.1 in the Appendix plots stock market participation for individuals who changed products and those who did not. The figure indicates that the two groups exhibited similar pre-treatment trends in stock market participation, whereas

participation rates diverged following the product change, with participation increasing more strongly among individuals who switched products. We estimate these effects using the following specification:[21]

$$StockMktPart_{it} = \sum_{j=2004}^{2009} \delta_j \cdot HighEquity_i \cdot 1[t = j] + \sum_{j=2011}^{2017} \delta_j \cdot HighEquity_i \cdot 1[t = j] + x_{it}\beta + \alpha_i + \theta_t \tag{6}$$

In this specification, *HighEquity* identifies pension fund members who switched pension products. Figure 5 reports the estimated coefficients from the regression, illustrating how the difference in stock market participation between individuals who switched products after being offered a choice to do so and those who did not evolved before and after the treatment.

Figure 5: Stock market participation – Difference-in-differences



Notes: This figure shows difference-in-difference results from regression 6. We show the point estimates δ_j with a 95% confidence interval. All estimates reflect the difference-in-difference effect relative to 2010, which serves as the baseline year.

Figure 5 reveals that we find no economically or statistically significant deviations from parallel trends prior to the product change. Following the pension reform, stock market participation increases among individuals who switched products relative to those who did

[21] We obtain qualitatively similar results using the doubly robust difference-in-differences estimator of Sant'Anna and Zhao (2020), the synthetic difference-in-differences estimator of Arkhangelsky et al. (2021), and the matrix completion estimator of Athey et al. (2021).

not. The estimated effects generally grow over time, culminating in a 2.5 percentage point difference in stock market participation rates between the two groups by 2017.[22]

These findings corroborate our baseline results and suggest that the increase in equity market participation induced by the product change is robust to alternative identifying assumptions. Specifically, the results hold both under the matching approach, which assumes that prior outcomes account for confounding unobservables, and under the difference-in-differences approach, which assumes that unobserved confounders are time-invariant.

4.3.2 Different treatment

In both the matching and the difference-in-differences analyses, treatment is defined by individuals' decision to switch pension products. As a result, the estimated effects may still be affected by self-selection.

To further mitigate concerns about selection bias, we adopt an alternative definition of treatment and control. Rather than defining treatment as the decision to switch products, we define treatment as membership in JØP at the time of the product change. Under this definition, treatment captures exposure to the opportunity to invest in a riskier pension product, regardless of whether the individual actively chose to switch. Consequently, all JØP members are considered treated.

This approach allows us to examine whether exposure to a riskier financial product within the pension fund affects stock market participation outside the pension system. Because exposure is determined by pension fund administrators rather than by individual choice, concerns about endogeneity are arguably less pronounced in this setting.

To implement this test, we expand the sample to include the entire adult Danish population and estimate the following regression separately for each year from 2010 to 2017:

$$StockMktPart_i = \alpha + \delta J\emptyset P_i + x_i\beta, \tag{7}$$

where $J\emptyset P_i$ is an indicator of whether an individual was a member of JØP. The analysis is restricted to individuals who had not participated in the stock market during the seven

[22]When comparing the magnitudes of the estimates obtained from the matching and difference-in-differences regressions, it is important to bear in mind that they are based on different samples and identifying assumptions. As mentioned, the difference-in-differences analysis uses the full sample of pension fund members, among whom nearly 40% participate in the stock market prior to the reform (cf. Table 2). This higher baseline participation rate naturally limits the scope for further increases and helps explain why the estimated effects in the Dif-in-dif regressions are smaller than those obtained from the matched sample, in which no individuals participate in the stock market prior to receiving the offer.

years preceding the product change.

The results can be seen in Figure B.2. We show that the effect is positive and increasing over time, with JØP members being 4.5 percentage points more likely to have entered the stock market by 2017 compared to a non member from the general population. Overall, this supports our story of the product change and the information that followed lowering barriers to entry.

4.4 Aggregate impact

To assess the economic significance of these results and gauge the extent of capital market deepening, using Scharfstein's (2018) terminology, we evaluate the average multiplier effect of each DKK pension wealth invested in the stock market. To do this we perform a back-of-the-envelope calculation to determine the average difference in non-pension stock market investment between individuals who changed products and the matched individuals who did not, divided by the difference in pension wealth invested in stocks. We limit our analysis to those with no exposure to the stock market prior to 2011 and find:

$$\frac{(Non\ pension_{\text{Treatm.}} - Non\ pension_{\text{Contr.}})}{(Pension_{\text{Treatm.}} - Pension_{\text{Contr.}})} = \frac{(85.56 - 53.70)}{(788.35 - 0)} = 0.04,$$

where *Non pension* is the average privately invested wealth in equities of individuals who either changed pension products (treatment) or not (control), and *Pension* is similarly the average pension wealth invested in equities of the same two groups. All numbers are 2017 values in DKK 1,000, as shown in Table 5, which summarizes the average wealth invested in equities privately or through pension funds.

Table 5: Multiplier effects

	High equity members	**Matched low equity members**	**Difference**
Average wealth in equities (DKK)	85.56	53.70	31.86
Average pension wealth in equities (DKK)	788.35	0.00	788.35

Notes: This table shows the sum of and average values of retirement and non-retirement wealth invested in equities separately for those who changed from low to high equity exposure products and the matched group of those who kept their low equity exposure products. We also show the difference between these two groups. We only display these values for those who did not participate prior to 2011. All values are in 1,000 DKK.

The calculations indicate that for each DKK the pension fund invests in the stock market resulting from the transfer of wealth from low to high equity products, an additional four cents are invested privately in stocks by affected pension fund members. In Section 6.1, we

will present results indicating how such estimates of the size of capital market deepening can vary with different investor characteristics.

5 Alternative explanations

The opportunity to choose the high-equity pension product is exogenously determined, whereas the decision to switch to the product is made by the individual. Although we have presented a range of analyses based on different identifying assumptions and consistently found qualitatively similar results, it remains relevant to directly examine alternative explanations and further assess the robustness of our findings. Most of the analyses presented below rely on the matching approach.

5.1 Differences in risk aversion

A potential alternative explanation to the learning-based one that we promote is that the positive effect on stock market participation that we observe might stem from unobserved differences in risk tolerance between the treatment and control groups, which our matching procedure may not fully capture. Although this explanation might initially appear intuitive, closer examination makes it less likely.

Most notably, if lower risk aversion was the driving factor behind stock market participation, why did these individuals not participate prior to being presented with the option to change pension products? Recall that we condition on individuals not participating in the stock market before being offered the choice to change products. If treated individuals were truly less risk averse, there would be no reason why they should delay participation until exactly that point in time where the individual is given the option to change products and the associated increase in exposure to financial investment information. The natural interpretation is that participation begins after the option because it reduces the cost of participating in the stock market.

Only in the case where risk aversion is time varying, and it for some reason starts falling for those individuals who changed products precisely at that point in time where the offer is made, could this in principle explain non-participation before the change and subsequent higher entry rates for those who changed products. Even when this hypothesis might appear as an unlikely explanation of our results, we still need to test it. We proceed as follows. If differences in (time-varying) risk aversion are to explain the difference in participation between the two groups, one would expect this to cause differences in not only stock market

participation, but also in other products related to risk attitudes, such as the willingness to pay for insurance. To test this, we run the following regression, using 2017 data, to examine the propensity of individuals to have voluntary unemployment insurance:

$$UI_i = \alpha + \delta HighEquity_i + UI_{i,2010} + x_i\beta, \tag{8}$$

where UI_i is a binary variable equal to 1 if an individual has voluntary unemployment insurance.[23] We limit our analysis to matched pairs where both individuals are employed, as otherwise the decision to have unemployment insurance is not meaningful. To ensure that past outcomes are properly controlled for, given that these were not exactly matched on prior to the product change, we include unemployment insurance status from 2010, $UI_{i,2010}$, as an additional control. Appendix B, Table B.3 presents the results of our regression analysis. We find a positive and insignificant relationship between changing products and the likelihood of having unemployment insurance. This suggests that differences in risk tolerance are not driving our findings, as we would expect a negative relationship if this were the case.

5.2 More active investors

A second possible alternative explanation for the observed positive effect on stock market entry from changing from a low equity to a high equity product is that individuals who change products are simply more active in their financial decision making (possibly indicated by making the active decision to change pension products). This could lead to the observed differences in stock market entry, as more active individuals are more likely to enter the market. To test this hypothesis, we leverage the fact that not all individuals changed products in 2011. Some individuals postponed the product change and only did so the following year, indicating they are less active. We redo the matching procedure by matching every individual who changed products in 2012 with a similar individual who changed products in 2011 (similar to comparing multiple treatments, cf. Lechner (2001), Lechner (2002)). We then run a regression comparing stock market participation of those who changed products in 2012 to those who changed in 2011. The results of this analysis (Appendix B, Table B.4) indicate that the difference in stock market entry and continued participation between these two groups is economically and statistically insignificant. This goes against the alternative explanation that differences in activeness drive the observed positive effect of the change to the high equity product on stock market entry.

[23] In Denmark, unemployment insurance is a voluntary addition to government unemployment benefits. Paying members of an unemployment insurance fund receive larger income coverage in the event of unemployment than people solely relying on government unemployment benefits.

5.3 Peer effects

To further rule out alternative explanations, as well as pin down that information is driving the increased stock market participation, we examine the behaviour of peers (family members within the same household) of those who change pension products. Specifically, we ask whether there is also an effect among family members who did not have the option to change pension products but may have received information indirectly from those who did.

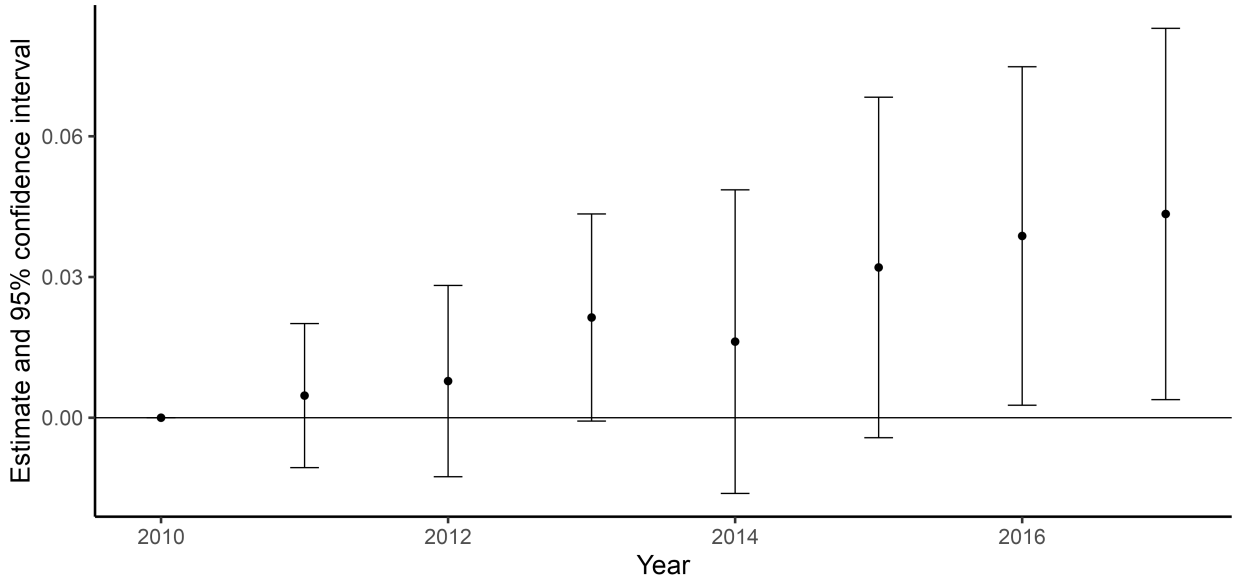
To explore this, we focus on households with more than one individual and where no family member was participating in the stock market in 2010 (the year before the product change). We match individuals who chose the market-sensitive product with those who retained the guaranteed product, following the same procedure as before. The outcome variable is a binary indicator equal to 1 if any family member, other than the person who changed pension products, begins participating in the stock market.

Figure 6, which shows the dynamic effects, reveals clear peer effects. Family members of those individuals who changed pension products also increase their stock market participation over time. However, these effects are smaller in magnitude compared to those observed for the individual who was directly exposed. While we found cumulative effects of approximately seven percentage points for those changing to the market-sensitive product (Figure 4), their family members are three to four percentage points more likely to enter the stock market than family members of those who retained the guaranteed product. It is intuitive that the effects are similar in nature but economically less pronounced. The results are statistically significant at the 5% or 10% level in most years, and the average effect on stock market entry across all years following the product change (i.e. the average of all coefficients in Figure 6) is strongly significant. Notably, as the family members did not decide to change products, it is much less likely that confounding unobservables can explain these results, which is why we interpret these peer-effect results as strong support that it is information and learning that impacts and drives the effect on participation in the stock market.

5.4 Using the general population as a control group

Another way to test the robustness of our identifying assumption is to compare the treatment effect to a control group who were never offered the product change, because they were not members of JØP. To do so, we create a control group from all Danes who had never had a market sensitive pension product in 2017 and who have not been members of our pension fund (JØP) during our sample period. Then we repeat our matching procedure from earlier, but match those who changed pension products with people from this new control group.

Figure 6: Peer effects



Notes: This figure shows the regression results from the regression in Equation (5), estimating the difference in stock market participation between family members of those who changed from low to high equity exposure products, and family members of those who kept their low equity exposure products every year after the product change. The dependent variable is a dummy indicating whether a family member other than the person who changed pension products owns equities. We include the point estimates and the 95% confidence interval. The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).

Then we rerun Specification (5) to investigate if those who changed pension products are more likely to enter the stock market. The results are presented in Table B.5. We find similar, albeit slightly weaker results compared to our main results. We find that those who changed products are 4-4.5 percentage points more likely to enter the stock market compared to the matched sample. This indicates that our main results are not driven by the control group simply being less likely to enter the stock market.

5.5 Correlations in the full population

In our main analysis, most of the pension fund members have an economics/business, law, or political science degree. As such they are on average better educated and have a higher income and net wealth than the general population.[24] To address this, we utilize data from Statistics Denmark on the pension wealth of all members of any Danish pension fund from

[24]The average net wealth in Denmark in 2010 was around DKK 380,000, and the average disposable income around DKK 200,000. The summary statistics is Table 1 reveal that individuals in our sample have higher incomes and wealth.

2014 to 2019, excluding individuals with no pension wealth in any given year. While we do not observe a clear event-driven increase in the financial risk of retirement savings, as in our main analysis, we can examine the (conditional) correlation between the risk of individuals' pension savings and their non-pension stock market participation. We run a regression of stock market participation on the fraction of pension wealth in market-sensitive products (i.e., pension products with higher financial risk) among the general population. Table B.6 in the Appendix reports the results, along with further details about the sample and estimation. We find that individuals with more risky pensions are also more likely to enter the stock market. This indicates that, while our main sample may not necessarily be representative of the general population in terms of their characteristics, the conclusions hold more broadly.

To sum up, this section has presented a series of tests designed to examine alternative explanations, such as the possibility that risk aversion and activeness drive our results.[25] We conclude from these tests that an information-driven channel, where peers of the affected individuals also respond, is the most reasonable explanation for our results. Moreover, our findings are robust across different empirical specifications and are mirrored in the general population.

6 Additional findings

In this section, we present findings that provide additional perspectives on our main conclusion that pension fund investments in financial markets contribute to capital market deepening.

6.1 Heterogeneity

While we document a substantial average effect, understanding the extent of heterogeneity in the response is important for assessing the broader implications of our findings. In particular, identifying which individuals are most likely to enter the stock market following a change in

[25] We do not examine other potential alternative explanations in detail because they appear less likely to account for our findings. For example, pension funds in Denmark are allowed to explain the characteristics of various pension plans, but regulations prevent them from issuing general recommendations. This reduces the likelihood that "endorsement effects" (Benartzi, 2001)—where investors interpret changes in pension plan allocations as implicit investment advice—play a significant role in explaining our results. Similarly, factors such as taxes, liquidity, and other frictions affecting the optimal allocation of assets between taxable and tax-exempt retirement accounts (e.g. Shoven and Sialm, 2002; Barber and Odean, 2004; and Huang, 2008) are also less likely to account for our findings, as these influences remain unchanged by adjustments to the pension plan in our setting.

pension products can shed light on the mechanisms underlying the effect and its relevance for different population groups.

To examine treatment effect heterogeneity, we investigate whether the estimated effects vary systematically across a range of socioeconomic and demographic characteristics. Specifically, we estimate the following regression for stock market entry:

$$StockMktPart_i = \alpha + \delta HighEquity_i + \gamma HighEquity_i \times x_{i,2010} + x_i\beta, \tag{9}$$

where $x_{i,2010}$ is the 2010 value of the following variables: liquid wealth (deposit and bond holdings), income, age, gender, and a dummy indicating an economics or business education. To ensure that δ can still be interpreted as the average treatment effect, we demean all elements of $x_{i,2010}$. Monetary variables are measured in DKK 100,000, and we include squared terms of liquid wealth, income, and age to allow for nonlinear heterogeneity in treatment effects. Table 6 presents the results of this regression.

We find significant treatment effect heterogeneity only with respect to liquid wealth, and the relationship is non-linear. Among individuals who did not own stocks prior to 2011, average liquid wealth in 2010 was approximately DKK 180,000, with a standard deviation of DKK 360,000. Thus, the effect of a pension product change is approximately six percentage points ($0.019 \cdot 3.6 - 2 \cdot 0.001 \cdot 1.8 \cdot 3.6 = 0.055$ or 5.5%; cf. Table 6, column 6) greater for someone with one standard deviation more liquid wealth than the average.

Given that liquid wealth plays an important role in shaping stock market participation following the pension product offering, it is natural to examine the implications of this heterogeneity for the aggregate effect of the product change estimated in Section 4.4. We repeat the analysis here, but now do it separately for individuals with liquid wealth (in 2010) above and below the median. The results are presented in Table 7. From this we can calculate multiplier effects for the two groups. For the wealthy, for every DKK of pension wealth invested in equities, roughly 0.066 was invested privately, whereas this number is just 0.011 for the less wealthy.

6.2 Participation mode

We have documented a positive effect on stock market entry but now investigate exactly what that new participation entails. We decompose the effect on stock market entry to determine the method of entry, i.e. we examine whether these individuals entered through indirect stockholding (via mutual funds), direct stockholding, or both. This is accomplished

Table 6: Heterogeneity

	Stock market participation					
	(1)	(2)	(3)	(4)	(5)	(6)
High equity exposure	0.070***	0.070***	0.071***	0.069***	0.069***	0.072***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)
High equity exposure × Liquid wealth	0.026***					0.019**
	(0.006)					(0.006)
High equity exposure × Liquid wealth sq.	-0.001**					-0.001*
	(0.000)					(0.000)
High equity exposure × Income		0.023				0.027
		(0.018)				(0.018)
High equity exposure × Income sq.		0.000				-0.001
		(0.002)				(0.002)
High equity exposure × Age			0.004			0.002
			(0.012)			(0.012)
High equity exposure × Age sq.			0.000			0.000
			(0.000)			(0.000)
High equity exposure × Female				-0.009		0.012
				(0.024)		(0.024)
High equity exposure × Economics education					0.023	0.024
					(0.025)	(0.025)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
No. obs.	14,674	14,674	14,674	14,674	14,674	14,674
R^2 adj.	0.062	0.052	0.053	0.049	0.050	0.066

Notes: This table shows the regression results from the regression in Equation 9, estimating the effect of changing from low to high equity exposure products, and various dimensions of heterogeneity in this effect. The dependent variable is a dummy indicating whether an individual owns equities. The variable of interest, "High equity exposure", is a dummy variable indicating whether an individual changed from low to high equity exposure products, which is interacted with the following 2010 variables: liquid wealth (deposits + bonds), income, age, a dummy indicating economics education, and a dummy equal to 1 if an individual is female. All DKK variables are measured in DKK 100,000, and "High equity exposure" is also interacted with the square of liquid wealth, income, and age. We only look at those who did not participate in the stock market prior to 2011. The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

through a multinomial logistic regression:

$$P(ParticipMode_i = j \mid x_i) = \frac{\exp(a_j + \delta_j HighEquity_i + x_i\beta_j)}{1 + \sum_{h \in J} \exp(a_h + \delta_h HighEquity_i + x_i\beta_h)}, \tag{10}$$

where $ParticipMode_i$ is the individuals' participation mode, which is defined among the set of investment options J ={Direct Stockholding, Mutual Funds, Both Individual Stocks and Mutual Funds}. The baseline is no stock investment. As before, we confine our analysis to individuals who did not participate in the stock market prior to the product change. Table

Table 7: Multiplier effects by wealth groups

	High equity members	Matched low equity members	Difference
Above median liquid wealth			
Average wealth in equities (DKK)	130.08	74.28	55.80
Average pension wealth in equities (DKK)	839.09	0.00	839.09
Below median liquid wealth			
Average wealth in equities (DKK)	41.02	33.11	7.91
Average pension wealth in equities (DKK)	737.59	0.00	737.59

Notes: This table shows the sum of and average values of retirement and non-retirement wealth invested in equities separately for those who changed from low to high equity exposure products and the matched group of those who kept their low equity exposure products. We also show the difference between these two groups. The table reports results separately for individuals above and below median liquid wealth in 2010. We only display these values for those who did not participate prior to 2011. All values are in 1,000 DKK.

8 presents the average partial effects of the change to the high equity exposure product.

Table 8: Participation mode

	Participation mode					
	Direct stockholding		**Indirect stockholding**		**Both**	
	(1)	(2)	(3)	(4)	(5)	(6)
High equity exposure	0.015	0.021^{*}	0.039^{***}	0.036^{***}	0.012^{**}	0.013^{***}
	(0.010)	(0.011)	(0.007)	(0.008)	(0.003)	(0.003)
Control variables	No	Yes	No	Yes	No	Yes
No. obs.	14,674	14,674	14,674	14,674	14,674	14,674
Pseudo R^2	0.011	0.074	0.011	0.074	0.011	0.074

Notes: This table shows the regression results from the multinomial logistic regression in Equation (10), estimating the 2017 effect of changing from low to high equity exposure products on the different modes of stock market participation. The dependent variable is a categorical variable indicating whether an individual has direct stockholdings only, indirect stockholdings only, or both (where the baseline value is neither). The variable of interest, "High equity exposure", is a dummy variable indicating whether an individual changed from low to high equity exposure products. We only look at those who did not participate in the stock market prior to 2011. All results are average partial effects from the multinomial logistic regression. Columns 1–2 show the effect on the probability of direct stockholding only, while columns 3–4 show the effect on the probability of indirect stockholding only, and columns 5–6 show the effect on the probability of owning both. The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

These effects disentangle our earlier findings into their constituent components, illuminating the extent to which each mode of participation drives the 7.0% effect on stock market participation.[26] The results reveal that, on average, individuals who changed products are

[26]Note that due to estimating the effect using a multinomial logistic regression, instead of the binary logistic regression used to model stock market participation, the total effect is slightly different from the 6.9

3.6 percentage points more likely to participate through indirect stockholding via mutual funds, 2.1 percentage points more likely to engage in direct stockholding, and 1.3 percentage points more likely to engage in both.[27] The impact on mutual fund holdings is particularly significant when keeping in mind that the general preference for investing in individual stocks over funds (as reflected in the summary statistics, and shown in Florentsen et al. (2019)). For instance, in 2010, only 3.4% of those who kept the low equity exposure product invested solely in mutual funds, implying that the 3.6 percentage point partial effect represents a doubling in mutual fund investment. In comparison, 26% were direct stockholders, so the 2.1 percentage point average partial effect corresponds to less than a 10% increase.[28]

Importantly, this result further supports the notion that the change to the high equity exposure product reduced individuals' participation cost as they gain familiarity with capital markets. This is because our results show that those who change pension products tend to choose investment vehicles that are similar to the high equity exposure product, which is a fund managed by professionals. These findings can be thought of as consistent with a model extension with multiple participation modes and different fixed costs, where a pension product change decreases the fixed costs of investing in mutual funds more than in stocks directly (larger ξ for more similar assets).

6.3 Risky asset shares

So far, we have mainly studied stock market participation, but higher participation rates do not necessarily translate into significant changes in the overall financial risk individuals are taking. Therefore, we examine the impact of the change to the high equity pension product on equity wealth and the proportion of financial assets invested in equities among individuals who did not participate in the stock market prior to 2011. To evaluate this impact, we run the following regression using 2017 data:

$$y_i = \alpha + \delta HighEquity_i + x_i\beta. \tag{11}$$

The outcome variables, y_i in the regression, are log(1+equity wealth), log(1 + stock wealth), and log(1 + mutual fund wealth), where equity wealth = stock wealth + mutual fund wealth,

percentage point effect Table 4 shows.

[27] We also study the dynamic impact on participation mode, which reveals that the effect on fund investment is increasing over time, which is coherent with our existing results, i.e. exposure makes the participation effect large over time as familiarity increases (cf. Appendix B, Figure B.3).

[28] Calculating average semi-elasticities, we draw a similar conclusion, i.e. that the effect on mutual fund participation is larger not only in absolute but also relative terms.

as well as y_i being the share of financial wealth in equities, stocks, and mutual funds.[29] The results, presented in Table 9, demonstrate that individuals who changed products invest $e^{0.793} - 1 = 121\%$ more on average and have a 2.9 percentage point higher share of financial assets in equities compared to those who kept their low equity exposure pension product. This is economically significant, given the generally low fraction of financial assets allocated to equities (cf. summary statistics in Table 2). For instance, in 2010, the average fraction of financial assets invested in equities was just 11.45% among those who kept the low equity exposure product. Thus, the 2.9 percentage point partial effect represents a 25% higher share invested in equities. These results indicate that individuals who entered the stock market due to the change in the high equity exposure product made economically significant investments in the stock market. Furthermore, the results align with the previous findings: three quarters of the flow into equities are going into mutual funds (2.1 percentage points relative to 2.9 percentage points, cf. Table 9, Panel B, columns 6 and 2). Thus, those who changed products are, on average, investing a significantly larger fraction of their wealth into equities, where most of it is going into mutual funds.

Finally, we investigate the risky asset share of those who already participated in the stock market prior to 2011. If individuals are integrating across different asset classes, they might not leave the stock market entirely due to the change in the high equity product but simply reduce their risky holdings. To investigate this, we run the regression in Equation (11) for those who participated prior to 2011. In addition to matching on prior participation, we also include as control variables the 2010 value of risky asset wealth (in logs), share of financial assets in mutual funds and directly in stocks (separately), and participation mode to ensure we are properly controlling for prior investment behaviour. The results (Appendix B, Table B.7) show a positive but insignificant effect of the product change on risky asset share. This provides evidence that individuals are not reducing their privately invested risky share, which reinforces the conclusions of the placebo test on continued participation mentioned in Section 4.1. If reductions in the fixed cost of entry are what is driving the main results, this result is as expected, namely no effect on those already participating in the stock market, neither in the form of continued participation nor change in risky asset share.

[29] Cohn, Liu and Wardlaw (2022) highlight the problems associated with using $log(1+y)$ as the dependent variable in regression analyses. Applying a Poisson regression—recommended by Cohn, Liu and Wardlaw (2022) to address these issues—produces comparable results.

Table 9: Equity wealth

Panel A: Value of wealth	Log(wealth) in:					
	Equities		**Stocks**		**Mutual funds**	
	(1)	(2)	(3)	(4)	(5)	(6)
High equity exposure	0.770***	0.793***	0.279*	0.350**	0.610***	0.571***
	(0.142)	(0.166)	(0.113)	(0.121)	(0.102)	(0.123)
Control variables	No	Yes	No	Yes	No	Yes
No. of observations	14,674	14,674	14,674	14,674	14,674	14,674
R^2 adj.	0.009	0.061	0.002	0.020	0.008	0.062
Panel B: Share of wealth	Share of wealth in:					
	Equities		**Stocks**		**Mutual funds**	
	(1)	(2)	(3)	(4)	(5)	(6)
High equity exposure	0.031***	0.029**	0.005	0.007	0.025***	0.021**
	(0.007)	(0.009)	(0.006)	(0.006)	(0.005)	(0.007)
Control variables	No	Yes	No	Yes	No	Yes
No. of observations	14,314	14,314	14,314	14,314	14,314	14,314
R^2 adj.	0.006	0.048	0.000	0.012	0.006	0.055

Notes: This table shows the regression results from the regression in Equation (11), estimating the 2017 difference in risky asset allocation between those who changed from low to high equity exposure products and those who kept their low equity exposure products. In panel A, the dependent variable in columns 1–2 is log(1+total equity wealth), in columns 3–4 it is log(1+direct stock wealth), and in columns 5–6 it is log(1+mutual fund wealth). In panel B, the dependent variable in columns 1–2 is share of financial assets in equities, in columns 3–4 it is share of financial assets in stocks, and in columns 5–6 it is share of financial assets in mutual funds. The variable of interest, "High equity exposure", is a dummy variable indicating whether an individual changed from low to high equity exposure products. We only look at those who did not participate in the stock market prior to 2011. The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

7 Concluding remarks

Do pension fund investments in capital markets induce households to change their exposure to financial markets in their non-pension portfolios? To evaluate this effect empirically, microeconometric evidence is needed that allows for exogeneous variation in pension fund exposure. Using data from a large pension fund, where some members experienced a significant increase in the equity exposure of their pension plan, we find that affected individuals increase their stock market exposure in their non-pension wealth. To help us interpret our results, we build a model that illustrates how pension funds' equity investments can reduce barriers to non-pension stock market entry and lead to a positive relationship between equity exposure in the pension fund and stock market participation in non-pension wealth, as we

find in the data.

Our results point to externalities in pension fund investments that require further investigation. For example, Abel (2001), Scharfstein (2018), and our paper implicitly assume that capital deepening is good because it positively affects economic growth opportunities. However, there is some debate in the literature about whether capital markets can become "too big" and pose a threat to financial and economic stability; see, e.g. Arcand, Berkes and Panizza (2012). While this is outside the scope of this paper, our results show that there is a spillover effect from pension fund investments to other household investments that should be taken into consideration when discussing financial stability and systemic risk.

We have studied a period during which returns on risky investments have generally been favourable, though not exceptionally high. This is an advantage, as it enables us to examine a scenario that reflects the long-term positive risk premium. However, it would be valuable for future research to explore whether different market conditions, such as a sharp market downturn, might lead to different behavioural responses.

We have focused on examining whether pension funds induce households to invest more or less of their non-pension savings in capital markets. Thus, our results also have implications for pension funds. Dahlquist, Setty and Vestman (2018) point out that pension funds have the potential to generate welfare gains by considering the stock market participation of their members as well as other relevant factors such as age and account balance. Our study demonstrates that the level of risk associated with an individual's pension fund has a direct impact on their stock market participation. A pension fund that seeks to compensate for its members' limited equity market participation by increasing investments in risky assets should therefore bear in mind that its investment decisions may influence its members' non-pension asset allocation.

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Appendices

A An extended four-period model with risk

The two-period model is a parsimonious way of describing the process through which investors can reduce the barriers associated with stock market entry. However, relative to the empirical specification it neglects two key features. First, the empirical analysis does not allow for a concurrent effect of acquiring the pension product on stock market entry. This captures the idea that the removal of barriers is not immediate. Second, Figure 1 clearly shows that the reduction in barriers develops over time, such that the effect on stock market entry increases with the duration since the choice of the pension fund product.

In this appendix, we extend the two-period model to a four-period one that addresses those two limitations. In the four-period model, the choice of entering the stock market in the first period, is not associated with reduced barriers, which can only happen later. Then, in periods 2 and 3, the investor faces an increasing profile of reduction in the barriers to enter the stock market. This is achieved by replacing the parameter ξ, which represented the decrease in participation cost for entry as a singleton in the two-period model, with the pair $\{\xi_2, \xi_3\}$, representing the decrease in the participation cost in periods 2 and 3, respectively, with $\xi_3 > \xi_2$. The decisions to enter the stock market are now denoted $\{S1, S2, S3\}$ for periods 1, 2 and 3, respectively. The rest of the elements in the model, such as log normal returns stay the same as in the two-period model.

We are now ready for introducing the four-periods model. Formally:

$$\max_{\{C_{i,t}\}_{t=1}^{4},\{A_{i,t}\}_{t=1}^{3},P,S1,S2,S3} \quad \mathbb{E}(\log(C_{i,1}) + \log(C_{i,2}) + \log(C_{i,3}) + \log(C_{i,4}))$$

$$\begin{aligned}
C_{i,1} &= (W_i - A_{i,1} - x_{i,P} * \mathbb{1}_P - x_{i,S} * \mathbb{1}_{S1})(1 + r_S * \mathbb{1}_{S1}) \\
C_{i,2} &= (A_{i,1} - A_{i,2} - x_{i,S} * \mathbb{1}_{S2} * (1 - \xi_2 * \mathbb{1}_P))(1 + r_S * max(\mathbb{1}_{S1}, \mathbb{1}_{S2})) \\
C_{i,3} &= (A_{i,2} - A_{i,3} - x_{i,S} * \mathbb{1}_{S3} * (1 - \xi_3 * \mathbb{1}_P))(1 + r_S * max(\mathbb{1}_{S1}, \mathbb{1}_{S2}, \mathbb{1}_{S3})) \\
C_{i,4} &= A_{i,3}(1 + r_P * \mathbb{1}_P).
\end{aligned}$$

Consumption in the first period is equal to initial wealth net of savings and possibly participation costs due to the choices of the high-equity pension product and the entry into the stock market. As mentioned above, the entry cost in this period is not reduced, as we assume that the barriers to entry have not been affected by the choice of the pension product. Consumption in periods 2 and 3 is equal to previous savings net of current savings and the

participation cost, where in each period that cost is decreased by the appropriate parameter ($\{\xi_2, \xi_3\}$). Notice that in periods 2 and 3, it is sufficient to have paid the participation cost in one of the periods (the max operators), as this is a one-time entry cost model. If $P = 0$, then the investor either enters the stock market in the first period or never, as delaying entry does not save her any cost and result with fewer periods with the premium return. In contrast, if the investor chooses $P = 1$, then the investor faces a trade-off between paying the participation cost early to achieve the premium return for more periods, and delaying the entry in order to experience a discounted participation cost due to the reduction in entry barriers. Finally, consumption in the fourth and last period is equal to savings including interest, if the high return pension product was chosen in the first period.

Using first-order conditions, the solution to the savings choices and the allocation of consumption, conditional on financial choices, is:

$$
\begin{aligned}
A_{i,1} &= \frac{3W_i - 3x_{i,P}\mathbb{1}_P - 3x_{i,S}\mathbb{1}_{S1} + x_{i,S}\mathbb{1}_{S2}(1-\xi_2\mathbb{1}_P) + x_{i,S}\mathbb{1}_{S3}(1-\xi_3\mathbb{1}_P)}{4} \\
A_{i,2} &= \frac{3W_i - 3x_{i,P}\mathbb{1}_P - 3x_{i,S}\mathbb{1}_{S1} - 3x_{i,S}\mathbb{1}_{S2}(1-\xi_2\mathbb{1}_P) + 3x_{i,S}\mathbb{1}_{S3}(1-\xi_3\mathbb{1}_P)}{6} \\
A_{i,3} &= \frac{3W_i - 3x_{i,P}\mathbb{1}_P - 3x_{i,S}\mathbb{1}_{S1} - 3x_{i,S}\mathbb{1}_{S2}(1-\xi_2\mathbb{1}_P) - 3x_{i,S}\mathbb{1}_{S3}(1-\xi_3\mathbb{1}_P)}{12} \\
C_{i,1} &= \frac{(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_{S1} - x_{i,S}\mathbb{1}_{S2}(1-\xi_2\mathbb{1}_P) - x_{i,S}\mathbb{1}_{S3}(1-\xi_3\mathbb{1}_P))(1 + r_S * \mathbb{1}_{S1})}{4} \\
C_{i,2} &= \frac{(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_{S1} - x_{i,S}\mathbb{1}_{S2}(1-\xi_2\mathbb{1}_P) - x_{i,S}\mathbb{1}_{S3}(1-\xi_3\mathbb{1}_P))(1 + r_S * max(\mathbb{1}_{S1}, \mathbb{1}_{S2}))}{4} \\
C_{i,3} &= \frac{(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_{S1} - x_{i,S}\mathbb{1}_{S2}(1-\xi_2\mathbb{1}_P) - x_{i,S}\mathbb{1}_{S3}(1-\xi_3\mathbb{1}_P))(1 + r_S * max(\mathbb{1}_{S1}, \mathbb{1}_{S2}, \mathbb{1}_{S3}))}{4} \\
C_{i,4} &= \frac{(W_i - x_{i,P}\mathbb{1}_P - x_{i,S}\mathbb{1}_{S1} - x_{i,S}\mathbb{1}_{S2}(1-\xi_2\mathbb{1}_P) - x_{i,S}\mathbb{1}_{S3}(1-\xi_3\mathbb{1}_P))(1 + r_P\mathbb{1}_P)}{4}
\end{aligned}
$$

Since we now have four binary decisions ($P, S1, S2$ and $S3$), we potentially have sixteen cases instead of four in the two-period model. However, ten alternatives are dominated by others. The first eight are all those where entry happens more than once. Those options are eliminated since there is no need to pay twice for entry in this one-time entry-cost model. Two additional dominated alternatives are choosing $P = 0$ and delaying the entry decision ($\{P = 0, S1 = 0, S2 = 1, S3 = 0\}$ and $\{P = 0, S1 = 0, S2 = 0, S3 = 1\}$). As explained above, absence of reduced participation costs, the investor can enjoy the premium return r_S in all of the first three periods by entering already in the first period ($\{P = 0, S1 = 1, S2 = 0, S3 = 0\}$). Applying Equation (2), this leaves us with the following six values for

the remaining combinations of financial choices. Each of those include a label, a 4-tuple of binary values indicating the financial choices $\{P, S1, S2, S3\}$, and the value for the investor (in the following line)

$$U = \begin{cases} 1.\ \text{Neither},\ \{P=0, S1=0, S2=0, S3=0\}: \\ 4\log(W_i) \\ 2.\ \text{High-equity Pension},\ \{P=1, S1=0, S2=0, S3=0\}: \\ 4\log(W_i - x_{i,P}) + \left(\mu_P - \frac{\sigma_P^2}{2}\right) \\ 3.\ \text{Stock Market (t=1)},\ \{P=0, S1=1, S2=0, S3=0\}: \\ 4\log(W_i - x_{i,S}) + 3\left(\mu_S - \frac{\sigma_S^2}{2}\right) \\ 4.\ \text{Both (entry at } t=1),\{P=1, S1=1, S2=0, S3=0\}: \\ 4\log(W_i - x_{i,P} - x_{i,S}) + \left(\mu_P - \frac{\sigma_P^2}{2}\right) + 3\left(\mu_S - \frac{\sigma_S^2}{2}\right) \\ 5.\ \text{Both (entry at } t=2),\{P=1, S1=0, S2=1, S3=0\}: \\ 4\log(W_i - x_{i,P} - x_{i,S}(1-\xi_2)) + \left(\mu_P - \frac{\sigma_P^2}{2}\right) + 2\left(\mu_S - \frac{\sigma_S^2}{2}\right) \\ 6.\ \text{Both (entry at } t=3),\{P=1, S1=0, S2=0, S3=1\}: \\ 4\log(W_i - x_{i,P} - x_{i,S}(1-\xi_3)) + \left(\mu_P - \frac{\sigma_P^2}{2}\right) + \left(\mu_S - \frac{\sigma_S^2}{2}\right), \end{cases} \tag{A.1}$$

where $-\log(256)$ is omitted from all values.

Figure B.4 uses the same state space as Figure 1 for the extended model, to depict the dominant values in Equation (A.1) over the two costs state space.[30]

The top panel, which excludes complementarity (reduced barriers) between the choices, is similar to that in Figure 1, with some differences resulting from the changes in model specification and parameter values. Notice that in this panel, the choices of changing the pension products and postponing stock-market entry by one or two periods ($\{P=1, S1=0, S2=1, S3=0\}$ and $\{P=1, S1=0, S2=0, S3=1\}$) are absent as those choices can only be justified in a model with reduced barriers.

Moving to the bottom panel, choices that include the high-equity pension dominate the left side of the picture due to the low cost of changing the pension products. Within that region, low costs of entering the stock market are associated with entering already in the first period,

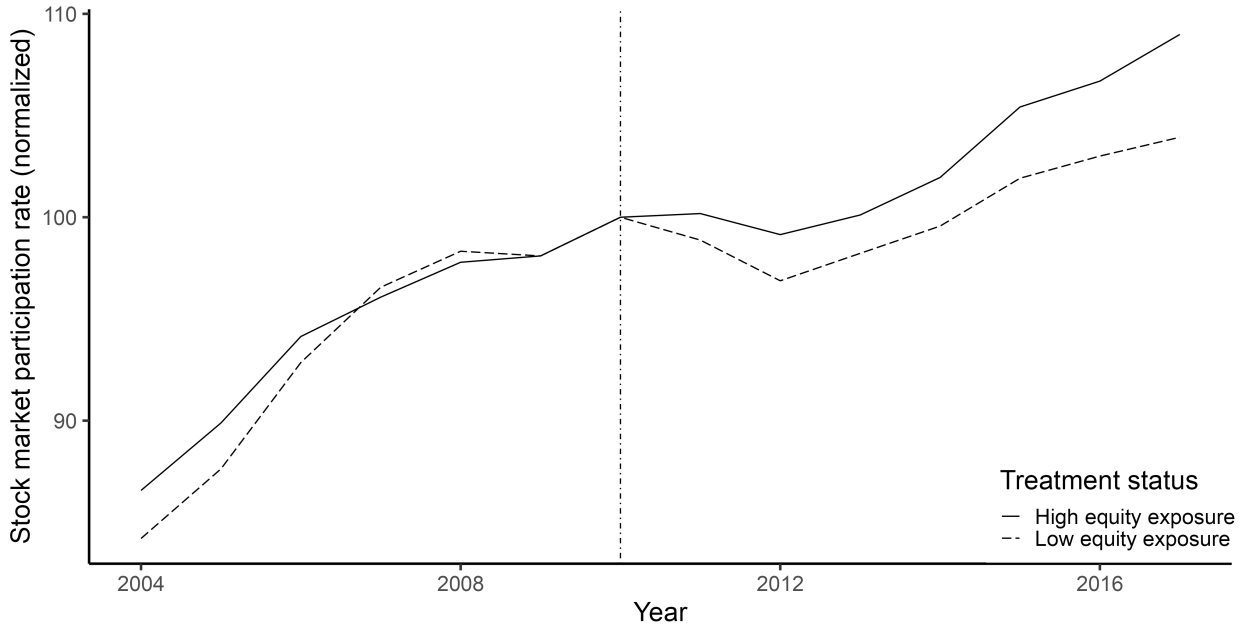
[30] The parameters for this figure are different from those of Figure 1 as follows: the premium return is 4% for stock market entry and 10% for the pension product, with the same standard deviation of 18%; and the decrease due to exposure to the high-equity pension is reduced by 50% in the second period and by 80% in the third period. These high decreases in the cost of entry (50% and 85%) are related to the high cost of postponing entry for one or two periods, which is equal to a large fraction of the working life in the model. In a more realistic model with many periods, it is expected that postponing entry by a few years would not be as costly.

in order to achieve the return from entry in all three work-life periods (labeled "Both, entry at t=1). For higher entry costs, it is worthwhile to postpone entry until the second period, in order to enjoy the benefit of reduced barriers to entry ("Both, entry at t=2). Then, for even higher costs of entry it is worthwhile to wait until the cost of barriers declines but even more in the third period, where the reduction in entry costs is at a level of ξ_3, rather than ξ_2 ("Both, entry at t=3). Finally, for high enough values of entry there is no entry ("High-equity Pension").

The complementarity between changing the pension products and entering the stock market (in the second and third periods) is also present in the center of the figure where entry with reduced barriers ("Both, entry at t=2" and "Both, entry at t=3") takes over, relative to the top panel, both "Neither" (top right corner) and "Stock Market Entry ($t = 1$)" (bottom right corner).

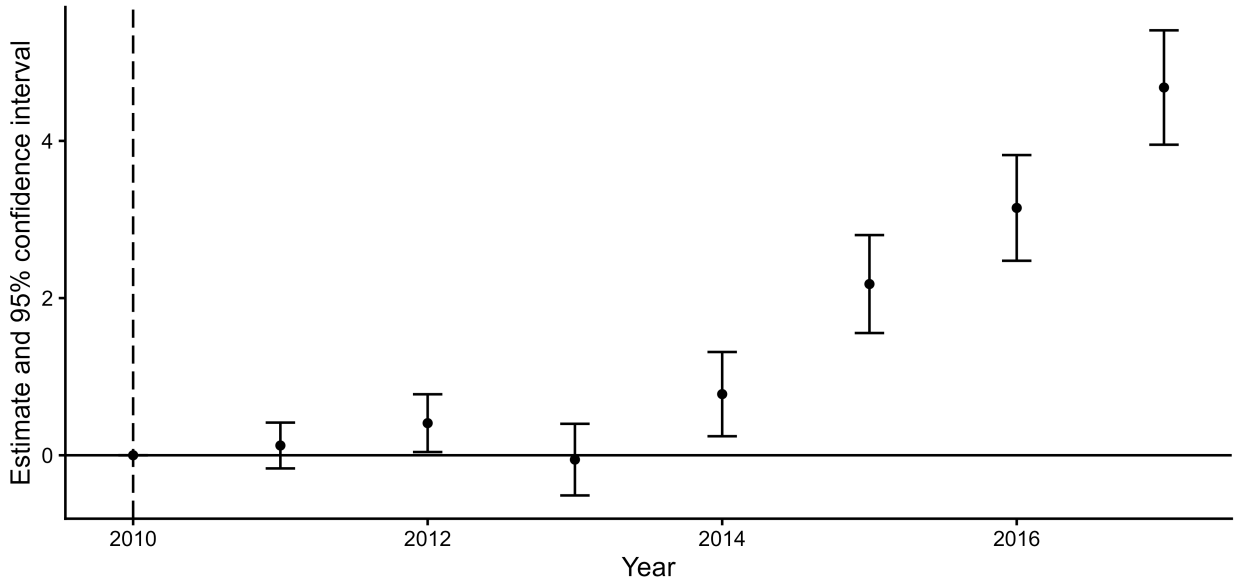
B Additional figures, tables and results

Figure B.1: Stock market participation



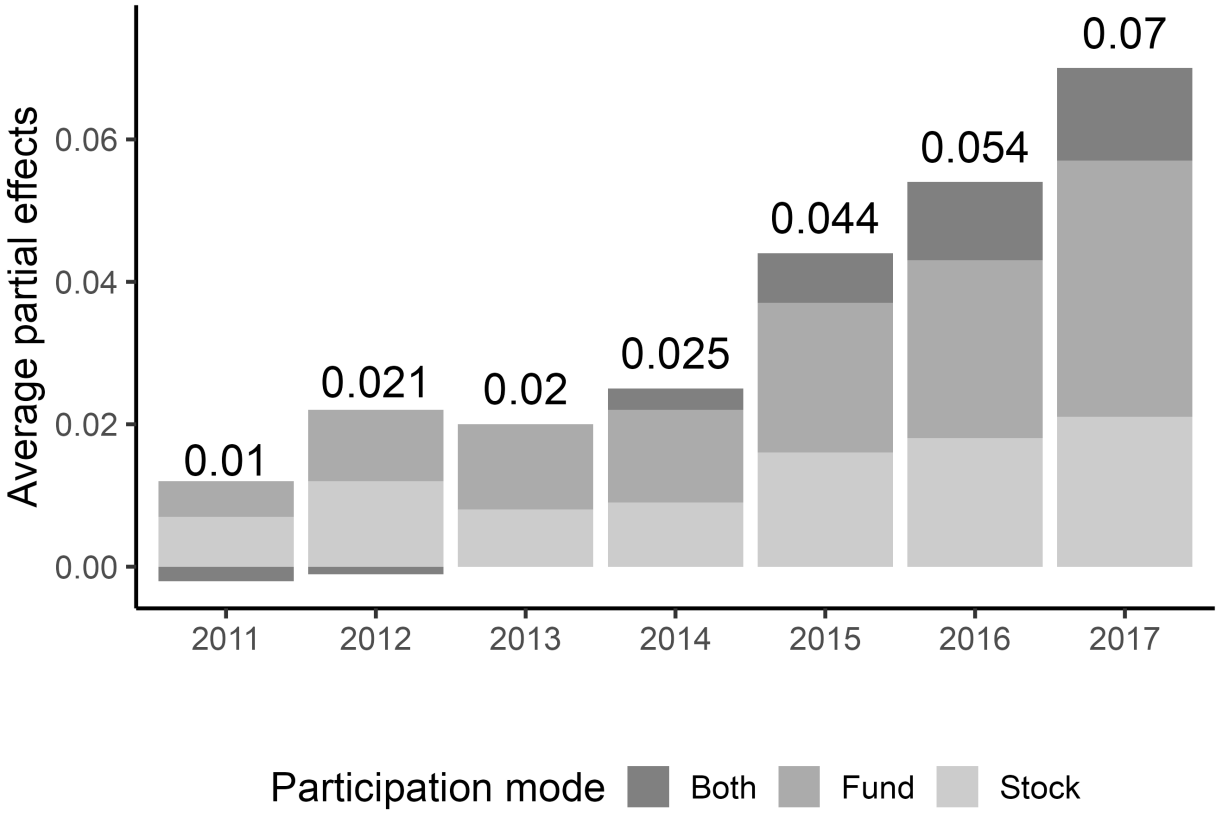
Notes: This figure shows stock market participation rates over time for those who changed from the low equity to the high equity exposure product and those who kept their low equity exposure product. We normalize the participation rates to 100 in 2010 (the year before the product change), to make it easier to see the parallel trends prior to the product change, and the divergent trends thereafter.

Figure B.2: Effect of JØP membership



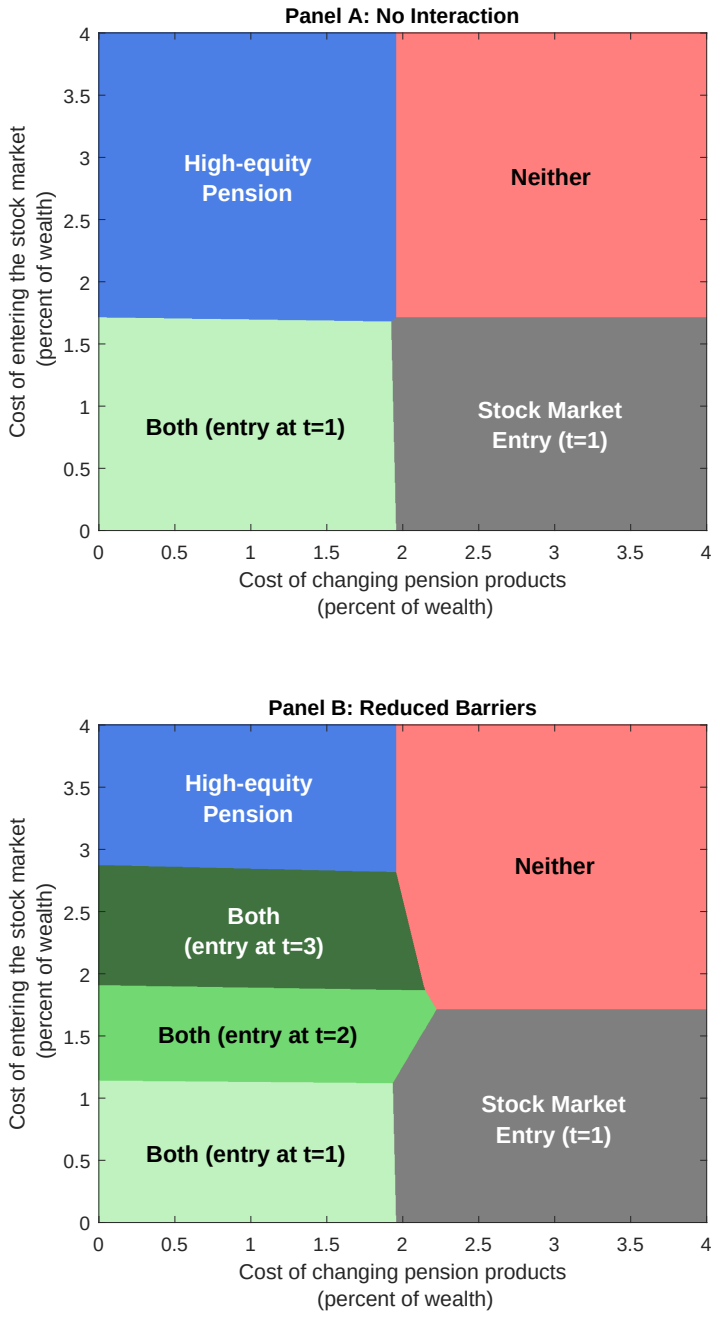
Notes: This figure shows the regression results from the regression in Equation (7), estimating the difference in stock market participation between JØP members and non-JØP members, for prior non-participants. We include the point estimates and the 95% confidence interval. The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).

Figure B.3: Participation mode over time



Notes: This figure shows the average partial effect of changing to the high equity exposure product on each participation mode. However, here we display the effects every year after the product change.

Figure B.4: Optimal financial choices in the four-period model



Notes: The figure illustrates the optimal financial choices over a horizontal grid of the cost of changing the pension products and the vertical axis of the cost of entering stock market. In this example, the premium return is 4% for entering the stock market and 10% for the high-equity pension product, with a standard deviation of 18%; and the range of the costs is [0%,4%] of initial wealth W. The top panel shows the optimal choices absent of reduced barriers. The bottom panel shows the choices given a 50% and an 80% reduction in the entry cost in periods 2 and 3, respectively, for an investor who changes the pension product.

Table B.1: Guaranteed rates

Contract inception date	**Guaranteed rate**
Before 01/01/1990	3.7% or 4.25%
01/01/1990 – 31/12/1996	3.70%
01/01/1997 – 30/06/1999	3.00%
01/07/1999 – 01/07/2005	2.00%
After 01/07/2005	0.00%

Notes: The table shows the different levels of guaranteed rate a member in JØP could receive, depending on the year in which they became a member.

Table B.2: Probability of product change

	Market-sensitive
	(1)
Pension wealth (100,000 DKK)	0.019***
	(0.001)
Age	0.000
	(0.001)
Female	-0.027***
	(0.009)
Owns stocks	0.031***
	(0.006)
Homeowner	0.035***
	(0.009)
Guaranteed rate = 3%	-0.019*
	(0.009)
Guaranteed rate = 3.7%	-0.017*
	(0.008)
Guaranteed rate = 4.25%	-0.053***
	(0.012)
Control variables	Yes
No. obs.	17,825
R^2 adj.	0.12

Notes: This table shows the average partial effects of certain variables of interest on the probability of changing pension product. The average partial effects are based on a probit regression: $P(MarketSensitive_i \mid x_{i,2010}) = \Phi(\beta x_{i,2010})$, where "Market-sensitive" is a dummy variable indicating whether an individual changed from the guaranteed to the market-sensitive product, and $x_{i,2010}$ is the set of variables later employed for matching.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table B.3: Unemployment insurance

	Unemployment insurance					
	Had no stocks before 2011			**Had stocks before 2011**		
	(1)	(2)	(3)	(4)	(5)	(6)
High equity exposure	0.033*	0.015	0.018	-0.003	0.021	0.012
	(0.014)	(0.014)	(0.013)	(0.024)	(0.024)	(0.017)
Control for past outcome	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	No	Yes	Yes	No	Yes	Yes
Logit	No	No	Yes	No	No	Yes
No. obs.	9,026	9,026	9,026	3,460	3,460	3,460
R^2 adj.	0.446	0.522	0.525	0.489	0.599	0.629

Notes: This table shows the regression results from regression in Equation 8, estimating the 2017 difference in unemployment insurance uptake between those who changed from the low equity to the high equity exposure product and those who kept their low equity exposure product. The dependent variable is a dummy indicating whether an individual has voluntary unemployment insurance. The variable of interest "High equity exposure" is a dummy variable indicating whether an individual changed from the low equity to the high equity exposure product. Columns 1–3 show the results for those who did not participate in the stock market prior to 2011. Columns 4–6 show the results for those who did. Columns 3 and 6 show average partial effects from a logistic regression. All regressions include the 2010 value of the outcome variable as a control. Standard errors are clustered at the individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table B.4: Late and early product change

	Stock market participation					
	Entry			**Continuation**		
	(1)	(2)	(3)	(4)	(5)	(6)
Changed product 2012	0.012	0.014	0.015	0.002	-0.004	-0.004
	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
Control variables	No	Yes	Yes	No	Yes	Yes
Logit	No	No	Yes	No	No	Yes
No. obs.	1,922	1,922	1,922	1,070	1,070	1,070
R^2 adj.	0.000	0.024	0.046	-0.001	0.023	0.075

Notes: This table shows the regression results from regression in Equation 5, estimating the 2017 difference in stock market participation between those who changed from the low equity to the high equity exposure product in 2012 and those who changed products in 2011. The dependent variable is a dummy indicating whether an individual owns equities. The variable of interest "Changed product 2012" is a dummy variable indicating whether an individual changed from the low equity to the high equity exposure product in 2012. Columns 1–3 show the results for those who did not participate in the stock market prior to 2011, thereby showing the effect on stock market entry. Columns 4–6 show the results for those who participated in the stock market prior to 2011, thereby showing the effect on continued stock market participation. Columns 3 and 6 show the average partial effects from a logistic regression. The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table B.5: Full population control group

	Entry			**Continuation**		
	(1)	(2)	(3)	(4)	(5)	(6)
High equity exposure	0.044***	0.041**	0.042***	0.001	0.000	-0.003
	(0.012)	(0.013)	(0.012)	(0.015)	(0.013)	(0.013)
Control variables	No	Yes	Yes	No	Yes	Yes
Logit	No	No	Yes	No	No	Yes
No. obs.	14522	14522	14522	8822	8822	8822
R^2 adj.	0.004	0.033	0.037	0.000	0.050	0.075

Notes: This table shows the regression results from the regression in Equation (5), estimating the 2017 difference in stock market participation between those who changed from low to high equity exposure products, and a matched control group from the general population who were not members of JØP and never had a market sensitive product. The dependent variable is a dummy indicating whether an individual owns equities. The variable of interest, "High equity exposure", is a dummy variable indicating whether an individual changed from low to high equity exposure products. Columns 1–3 show the results for those who did not participate in the stock market prior to 2011, thus showing the effect on stock market entry. Columns 4–6 show the results for those who participated in the stock market prior to 2011, thus showing the effect on continued stock market participation. Columns 3 and 6 show the average partial effects from a logistic regression. The standard errors are clustered at the individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Details for Table B.6

We run the following regression:

$$StockMktPart_{it} = \alpha_i + \theta_t + \delta FracPensionRisk_{it} + x_{it}\beta \tag{B.1}$$

where $FracPensionRisk_{it}$ is the fraction of total pension wealth invested in market-sensitive products (measured in percentage points), and x_{it} is the same control variables we used for matching in the JØP-sample.[31] We control for unobservable confounders by using individual fixed effects α_i, thus exploiting within-individual variation in the fraction of pension wealth in market-sensitive products.

In Table B.6, we present the results of Regression B.1. Column 1 shows that a 1%-point increase in the fraction invested in market-sensitive products raises the probability of equity ownership by 0.014 percentage points. This estimate is based on the entire sample, where the variation in the fraction invested in market-sensitive products is limited over time, primarily driven by small, passive changes, such as the effects of returns and contributions. Hence, we further limit our sample in Column 2 to individuals who only had guaranteed products at the start of our sample (2014). For these individuals, within individual changes in the fraction invested in market-sensitive products represents larger, more active changes, such as moving to an employer with a market-sensitive fund, or experiencing a product change such the one at JØP.[32] The size of the effect increases to 0.019 percentage points. Guided by our main analysis, where we found the biggest effect amongst those who did not participate before the product change, in Column 3 we further limit the sample to those who only had guaranteed products and did not participate in the stock market in 2014. The effect nearly doubles to 0.032 percentage points. To provide a better understanding of the economic significance of the results, we rerun the regressions with dummy variables indicating the fraction invested in market-sensitive products, with 0% being the reference level. The results reveal that a non-participant who goes from 0% in 2014 to the smallest positive amount invested in

[31] Total pension wealth is the sum of all pension wealth an individual has, including the Danish compulsory defined contribution scheme and privately managed pension wealth. We consider privately managed pension wealth as market-sensitive (as no information is provided on this), and the compulsory pensions as guaranteed. However, our results are robust to only using employer managed pension wealth, where we know with certainty how much is invested in market-sensitive products.

[32] To see the differences in variation between these two samples, we run the following regressions in both samples: $FracPensionRisk_{it} = \alpha_i + \theta_t$ and compare the R^2 squared to see how much variation is soaked up by the fixed effects. In the full sample the $R^2 = 0.89$, indicating that the fixed effects explain almost all the variation in the fraction invested in market-sensitive products. For the sample who had only guaranteed products in 2014, the $R^2 = 0.59$ is significantly smaller, indicating there is much more residual variation in the $FracPensionRisk_{it}$ after controlling for these fixed effects.

market-sensitive products in a later year becomes 1.4 percentage points more likely to buy stocks (Column 6). This effect is relatively stable, except at high fractions invested in market-sensitive products, where a non-participant going from 0% to 80–100% becomes 3.6 percentage points more likely to buy stocks.

The results of this analysis, while smaller in magnitude than those from the main analysis, provide support for the external validity of our main analysis. The fact that the effects observed in the general population are positive is indicative of a large-scale capital market deepening.

Table B.6: Fraction of pension wealth invested in market-sensitive products

	Stock market participation					
	(1)	(2)	(3)	(4)	(5)	(6)
Fraction in market-sensitive (%)	0.00014***	0.00019***	0.00032***			
	(0.00000)	(0.00001)	(0.00001)			
0% < Market-sensitive < 20%				0.00255***	0.00817***	0.01355***
				(0.00033)	(0.00054)	(0.00051)
20% < Market-sensitive < 40%				0.00474***	0.00729***	0.01242***
				(0.00038)	(0.00070)	(0.00064)
40% < Market-sensitive < 60%				0.00481***	0.00670***	0.01211***
				(0.00039)	(0.00070)	(0.00063)
60% < Market-sensitive < 80%				0.00713***	0.00883***	0.01611***
				(0.00039)	(0.00069)	(0.00063)
80% < Market-sensitive < 100%				0.01366***	0.02169***	0.03561***
				(0.00046)	(0.00092)	(0.00088)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Individual fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
No. obs.	24,904,604	8,316,618	6,578,961	24,904,604	8,316,618	6,578,961
R^2 adj.	0.869	0.877	0.500	0.869	0.877	0.501

Notes: This table shows the regression results from the regression in Equation B.1, estimating the effect of the fraction of pension wealth invested in market-sensitive products on stock market participation. The dependent variable is a dummy indicating whether an individual owns equities. The variable of interest "Fraction in market sensitive" is the fraction of total pension wealth invested in market-sensitive products, measured in percentage points (columns 1–3). In addition, we also use dummies indicating the level of this variable, where the estimates should be interpreted relative to having 0% invested in market-sensitive products (columns 4–6). Columns 1, and 4 show the results for everyone with pension wealth in Denmark. Columns 2, and 5 show the results for everyone with pension wealth in Denmark who had 0% invested in market-sensitive products in 2014. Columns 3, and 6 show the results for everyone with pension wealth in Denmark who had 0% invested in market-sensitive products and did not invest in 2014. The standard errors are clustered at an individual level.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table B.7: Equity wealth – Prior participants

	Share of wealth in equities		**Log(wealth) in equities**	
	(1)	(2)	(3)	(4)
High equity exposure	0.010	0.020	-0.048	-0.017
	(0.021)	(0.024)	(0.207)	(0.219)
Control for past outcome	Yes	Yes	Yes	Yes
Control variables	No	Yes	No	Yes
No. obs.	9,400	9,400	9,450	9,450
R^2 adj.	0.302	0.321	0.362	0.383

Notes: This table shows the regression results from regression in regression in Equation (11), estimating the 2017 difference in stock market participation between those who changed from the low equity to the high equity exposure product and those who kept their low equity exposure product. The dependent variable in in columns 1-2 is share of financial assets in equities, and in columns 3-4 is log(1+total equity wealth). The variable of interest "High equity exposure" is a dummy variable indicating whether an individual changed from the low equity to the high equity exposure product. We only look at those who participated in the stock market prior to 2011. All regressions include the 2010 value of participation mode, log(1+total equity wealth), and share of financial assets in mutual funds and direct stockholding (separately). The standard errors are clustered at an individual and matched pair level (Austin and Cafri, 2020).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

C Material from pension fund to members

3. november 2011
JØP nr. XXXXX

Jeg skriver til dig med et tilbud om omtegning af din pensionsordning i afdeling 1, der kan få stor betydning for din pension.

Som forholdene ser ud i dag taber din pension købekraft år for år. Tager du imod dette tilbud om omtegning af din JØP-ordning forventer bestyrelsen, at du vil få en højere pension, der bedre kan følge med inflationen.

Hvis du omtegner, kan pensionskassen frigive bundne reserver i et omfang, der for dit vedkommende vil udløse en omtegningsbonus på **X kr.** opgjort pr. 30. september 2011[1].

Vi har på dette grundlag beregnet din pension før og efter omtegning:

Hvis du **vælger at omtegne** din nuværende ordning, vil du som XX-årig få en alderspension på **X kr.** årligt ifølge vores prognose. Beløbet er sammensat af en livsvarig alderspension og en 15-årig ydelse. Der udbetales ikke pensionisttillæg, hvis du omtegner.

Ved omtegning bortfalder din nuværende ydelsesgaranti. Alligevel mener vi, at sikkerheden for din pension reelt bliver større – det forklarer vi i den vedlagte folder.

Hvis du vælger **ikke at omtegne** din nuværende pensionsordning, vil du som XX-årig få en alderspension på **X kr.** årligt ifølge vores prognose.

Hvad skal jeg gøre?
Omtegningen skal ske på JØPs hjemmeside `www.joep.dk` **senest den 30. november 2011** ved brug af NemID. Kontakt JØP, hvis du ikke har adgang til internettet. Hvis du ikke ønsker at omtegne, skal du ikke foretage dig noget. Omtegningen vil få virkning fra 1. januar 2012.

På `www.joep.dk` finder du din omtegningsoversigt med tal for din pension før og efter omtegning samt uddybende forklaringer og baggrund. Brevet her bør ikke alene danne grundlag for din beslutning. Læs derfor vedlagte folder og besøg hjemmesiden, der har mere information.

På bestyrelsens vegne

Agnete Raaschou-Nielsen, formand

De viste beløb for pension og omtegningsbonus er beregnet pr. 30. september 2011. De endelige beløb beregnes på grundlag af årsregnskabet pr. 31. december 2011.

Figure C.1: JØP

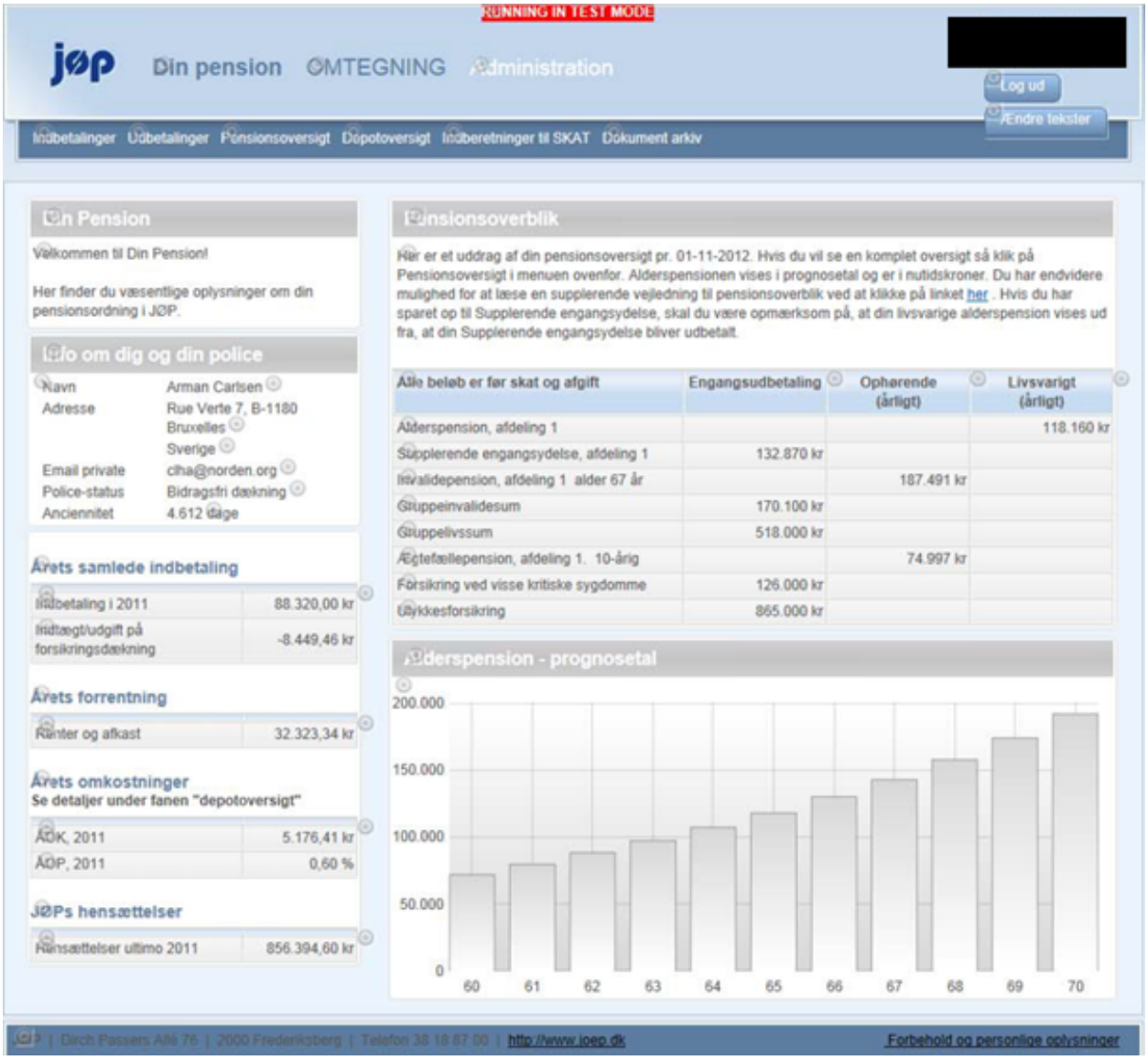
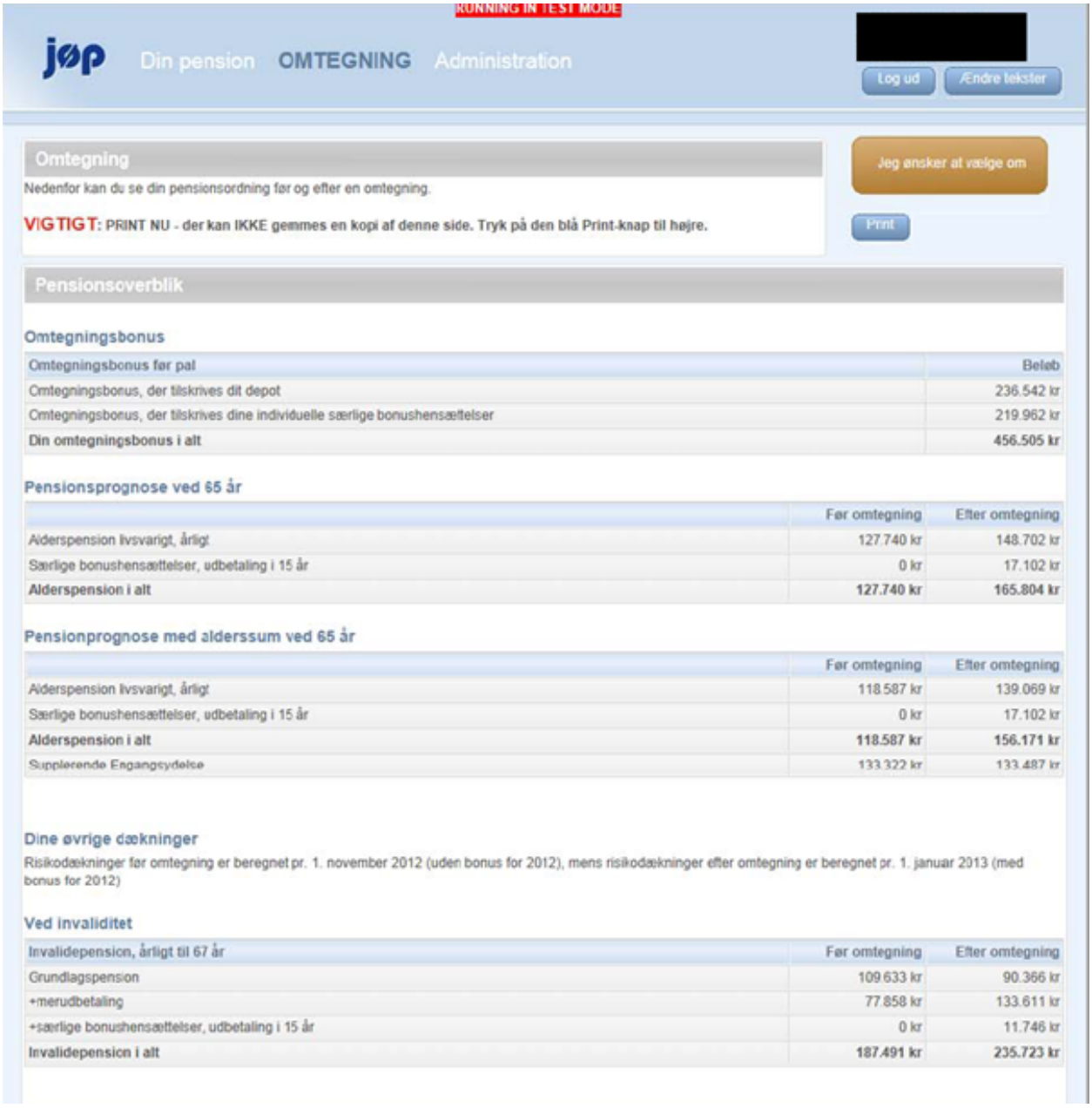


Figure C.2: JØP



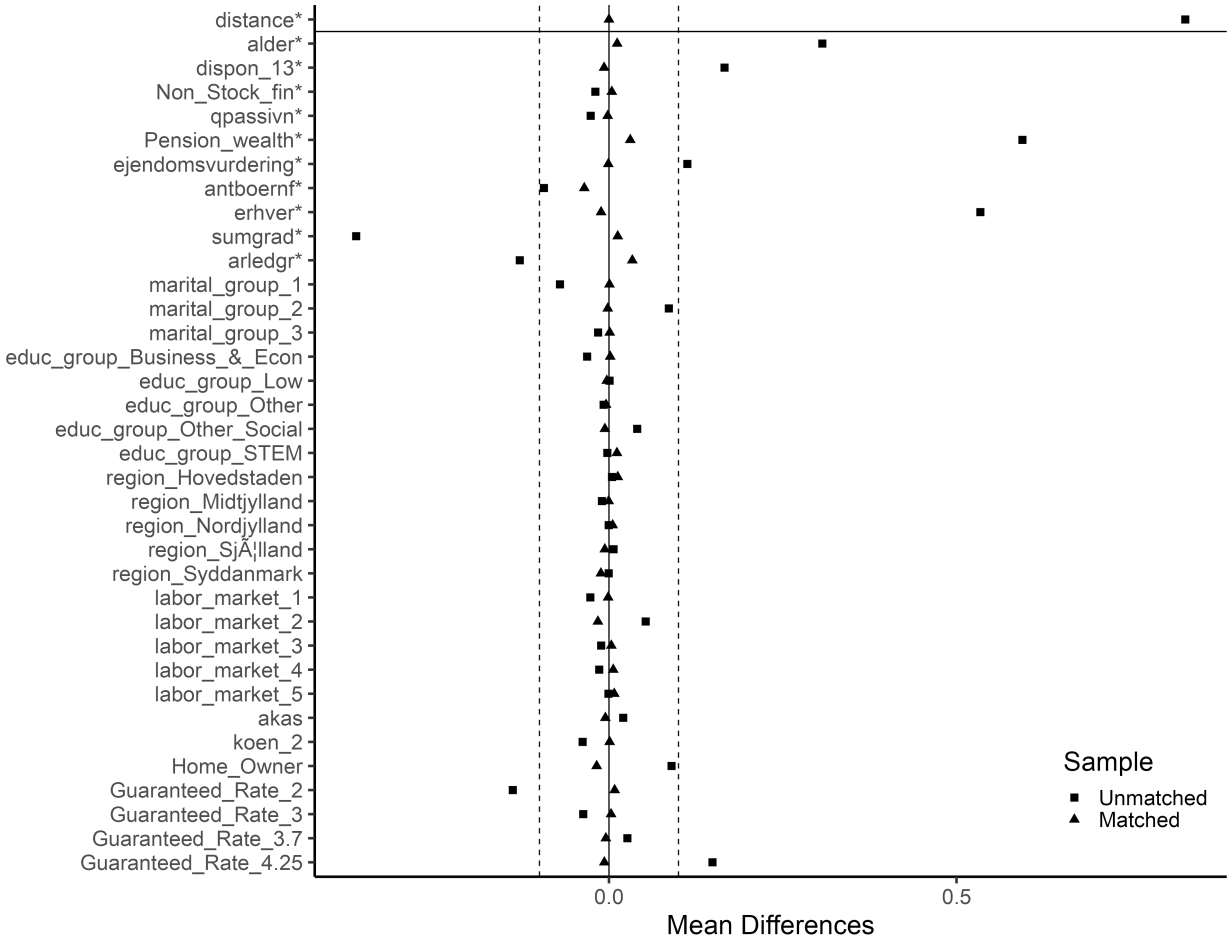
D Matching quality

Table D.1: Summary statistics

	Panel A: Had no stocks before 2011				Panel B: Had stocks before 2011			
	Kept low Kept low equity exposure		Changed to high equity exposure		Kept low equity exposure		Changed to high equity exposure	
Numerical variables	*Mean*	*Std*	*Mean*	*Std*	*Mean*	*Std*	*Mean*	*Std*
Propensity score	81.11%	9.84%	81.11%	9.84%	85.80%	9.84%	85.80%	9.84%
Wealth in equities (DKK)	0.00	0.00	0.00	0.00	244,882.27	529,987.59	285,488.43	576,768.89
Share of financial wealth in equities	0.00%	0.00%	0.00%	0.00%	30.11%	28.89%	31.25%	29.42%
Number of stocks	0.00	0.00	0.00	0.00	2.83	4.30	2.88	4.09
Non-equity financial wealth (DKK)	185,591.40	337,590.00	187,100.48	371,592.94	539,459.64	844,884.36	570,902.04	872,148.80
Housing wealth (DKK)	1,294,854.88	1,147,631.82	1,293,767.93	1,145,306.49	1,800,052.12	1,790,936.77	1,879,002.99	1,769,253.85
Total liabilities (DKK)	1,052,508.28	945,824.57	1,050,788.33	917,979.11	953,433.77	1,169,897.88	1,043,175.78	1,245,569.45
P+ pension wealth (DKK)	1,107,850.66	890,049.09	1,132,948.40	813,864.99	1,495,420.35	1,208,751.18	1,448,667.51	1,018,367.48
Guaranteed rate	3.38%	0.87%	3.36%	0.87%	3.68%	0.80%	3.65%	0.82%
Age	47.61	9.35	47.72	9.60	53.39	11.27	52.91	11.20
Disposable income (DKK)	336,060.23	145,416.27	335,065.29	142,010.28	370,339.53	216,481.16	374,948.71	215,388.39
No. children living at home	1.26	1.14	1.22	1.12	0.83	1.09	0.84	1.08
Work experience (years)	18.48	7.41	18.40	7.36	20.19	7.63	20.15	8.14
Lifetime unemployment (years)	0.81	1.39	0.83	1.46	0.53	1.16	0.56	1.34
Categorical variables	Fractions		Fractions		Fractions		Fractions	
Stock market participation	0.00%		0.00%		100.00%		100.00%	
Direct stockholding only	0.00%		0.00%		65.82%		61.10%	
Indirect stockholding only	0.00%		0.00%		8.08%		7.51%	
Both direct and indirect	0.00%		0.00%		26.10%		31.39%	
Female	49.41%		49.50%		39.41%		38.56%	
Highest education: Business or economics	24.79%		24.97%		34.14%		33.80%	
Highest education: Other social science	65.23%		64.64%		57.57%		57.35%	
Highest education: STEM	3.91%		5.06%		2.24%		2.96%	
Highest education: Other higher education	2.54%		2.11%		0.97%		1.38%	
Employed	91.69%		90.09%		74.56%		78.29%	
Self-employed	2.52%		2.40%		4.68%		5.04%	
Retired	4.72%		5.48%		18.79%		14.03%	
Homeowner	82.49%		80.71%		82.31%		84.72%	
Unemployment insurance	81.40%		80.88%		61.95%		65.95%	
Has spouse	74.10%		73.93%		74.86%		70.98%	
Separated	9.60%		9.70%		9.23%		11.68%	
Capital Region	58.58%		59.85%		57.86%		59.43%	
No. observations	7,337		7,337		4,725		4,725	
No. individuals	1,504		7,337		735		4,725	

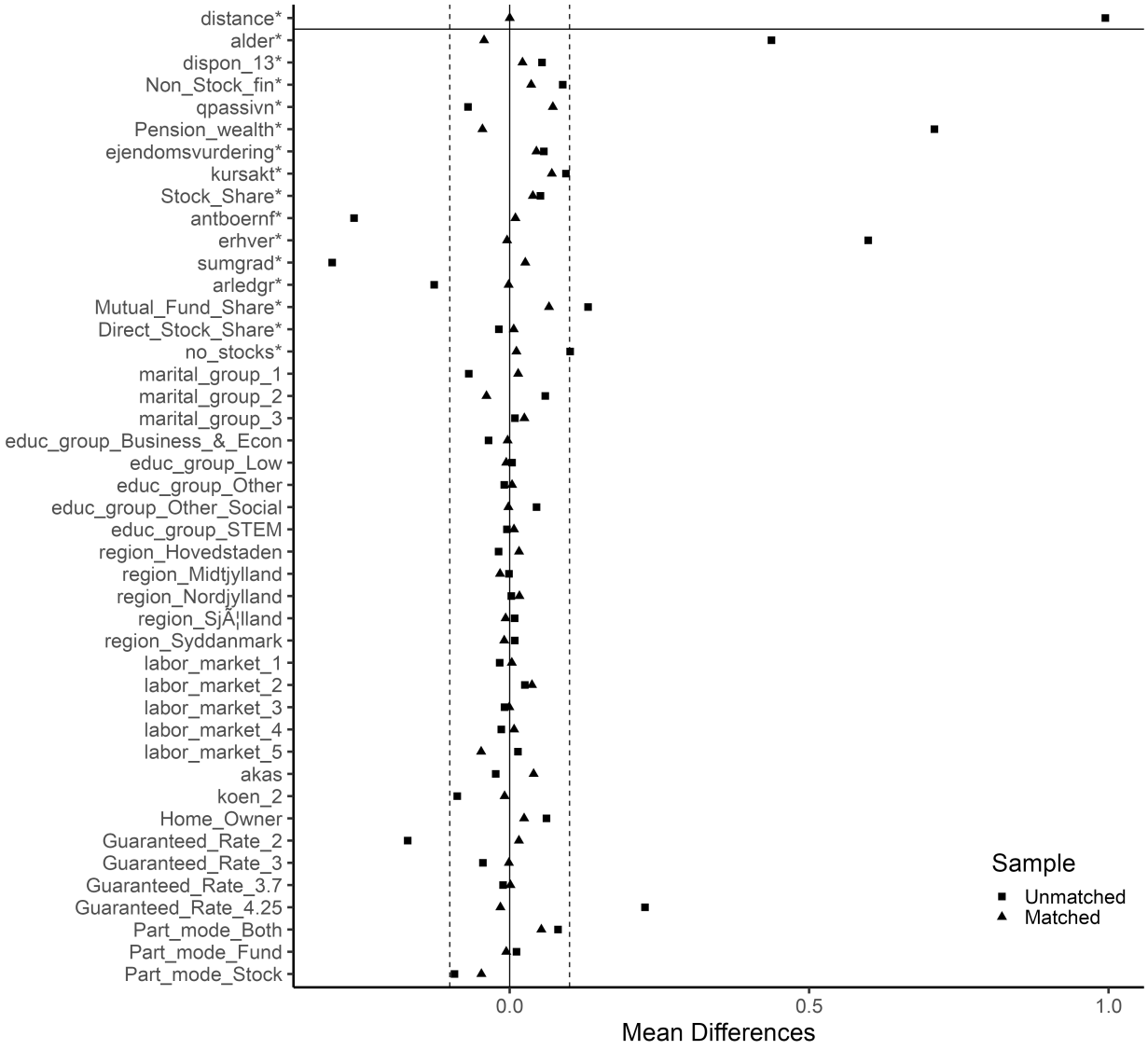
Notes: The table shows the mean and standard deviation for relevant variables. The numbers are from 2010, the year before the product change. In panel A, we present these statistics for those who changed products and did not participate in the stock market prior to 2011, then for the matched group of people who also did not participate in the stock market but chose to keep the low equity exposure product. In panel B, we present these statistics for those who changed products and participated in the stock market prior to 2011, then for the matched group of people who also participated in the stock market but chose to keep the low equity exposure product. All DKK variables are winsorized within each year at the 1st and 99th percentiles, and are inflation adjusted to December 2010 DKK. Medians are not reported due to Statistics Denmark reporting restrictions.

Figure D.1: Standardized mean difference – Non-participants



Notes: The figure shows the standardized mean difference (difference in means divided by standard deviation) in continuous covariates (*) between those who changed from the low equity to the high equity exposure product and those who kept their low equity exposure product, before and after matching was employed. For categorical variables we show the raw difference in fractions. Bounds are displayed at -10% and 10%. We show it for those who did not participate in the stock market prior to 2011.

Figure D.2: Standardized mean difference – Participants



Notes: The figure shows the standardized mean difference (difference in means divided by standard deviation) in continuous covariates (*) between those who changed from the low equity to the high equity exposure product and those who kept their low equity exposure product, before and after matching was employed. For categorical variables we show the raw difference in fractions. Bounds are displayed at -10% and 10%. We show it for those who participated in the stock market prior to 2011.