HOUSEHOLD REACTIONS TO DEFINED BENEFIT PENSION RISK*

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Abstract

We show that pension fund risk in hybrid Defined Benefit plans has important effects on individual portfolio choice. More pension risk decreases individual financial equity holdings, and increases individual cash holdings. This holds for the extensive as well as the intensive margin. Consistent with our main hypothesis, the effects of pension risk are more prominent among those who are better informed about their pension plan risk, the retirees, and those approaching retirement age. Those better informed about their pension risk also increase their expected retirement age when their pensions are at risk. Our results show that people adjust their individual portfolios when exposed to pension background risk, and suggest that properly funded DB pension plans can increase retiree welfare by allowing individuals to take more risk in their individual portfolios.

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Keywords: Pension risk; Household portfolio; Defined Benefit pensions; background risk

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1. INTRODUCTION

One of the lessons of the current financial crisis is that no one is safe from asset price declines. This is particularly true for those who directly participate in the stock market as well as for people who hold pension savings in Defined Contribution (DC) plans. However, also those who seem to be sheltered from stock market fluctuations because they have a Defined Benefit (DB) pension plan are often still exposed to financial risks through their pension savings. This is because DB pension funds might also suffer stock market losses and, in some jurisdictions, lay the burden of their losses on their affiliates through lower indexation, contribution increases, and even cuts in benefits and pension accruals. This is in particular true when the DB plan has evolved from a traditional DB arrangement, in which the burden of adjustment fully takes place via an increase in contributions, to hybrid schemes, that explicitly link replacement rates and contribution rates to the market performance of the fund. Such hybrid schemes are currently in place in various countries, such as the Netherlands, Canada, and Luxembourg, and Switzerland. In most countries where hybrid DB plans are available, their market share has been rising over the last decade (OECD Global Pension Statistics, retrieved March 2013). Yet we know little of how individuals respond to the risks in their DB pension savings. Are DB pension plan affiliates aware of the risk their pension savings bear? How do they react to such risk?

In this paper we develop a measure for hybrid DB pension risk from the perspective of the pension plan contributors and beneficiaries, and analyze their reaction to this type of pension risk. In particular, we look at the effect of pension risk on individual portfolio allocations to equity and cash, as well as on labor supply.

Our empirical analyses refers to the pension system in The Netherlands. Dutch retirement plans have three characteristics that provide excellent grounds for answering our research question. First, even though there is a large number of pension funds operating in The Netherlands, employees cannot freely choose to which one they contribute; each organization has a pre-assigned pension fund for all its employees. This institutional feature impedes people to simply switch pension funds when they are dissatisfied with the fund's risk strategy or performance. Therefore, Dutch workers only have their own

asset holdings as a means to optimize their financial risks. While this feature facilitates our analyses, it does not mean that our results are only relevant counties where there is no free pension fund choice. Our results will apply to any market with prohibiting pension fund switching costs, or large enough legal and bureaucratic hassles.

Second, for Dutch households DB retirement plans are the predominant tool for retirement saving in the second pillar. Third, since 2003 Dutch retirement plans have evolved from traditional DB into hybrid DB. Pension benefits are still linked to wages, but the indexation of benefits and pension accruals to inflation is now conditional on the financial position of the pension fund, and therefore linked to financial market developments (Ponds and Van Riel, 2009). This feature exacerbates the market risk sustained by DB scheme affiliates and allows us to obtain precise estimates of the effect of pension risk on individual investment behavior.

For our empirical analysis, we use uniquely matched data on the pension funds' funding ratio and performance from the Dutch National Bank (DNB) and a representative survey on private savings and investments of Dutch households. This provides us with a rich set of characteristics and observed behavior at the individual level that we correlate to pension fund risk.

Our findings show that individuals who bear more pension risk are less likely to invest in financial equity and more likely to keep their money in liquid instruments such as saving accounts. This holds for the extensive margin—the decision to hold equity instead of holding all financial wealth in riskless savings—as well as the intensive margin—the wealth share allocated to equity and the wealth share allocated to cash. The impact of pension risk is generally strongest for people who are aware of their pension indexation status, for those approaching the mandatory retirement age of 65, and for retirees. There is some evidence that people also adjust their labor supply in response to pension risk by decreasing their retirement age when their pension savings are safer, although this effect only holds for those who are aware of their pension risk.

To the best of our knowledge, we are the first who quantify household reactions to DB pension fund risk. Most of the current literature on individual pension decisions is focused on whether individuals

are capable of optimal decision-making when it comes to saving for retirement, and in particular when it comes to allocating their DC pension wealth. Benartzi and Thaler (2001, 2007) show that people are excessively passive and that they often fall prey to naïve diversification strategies when they manage their retirement portfolios. Van Rooij et al., (2007) show that Dutch people consider themselves to be financially unsophisticated and often prefer DB over DC schemes to avoid having to make complicated pension-related decisions. These studies paint a picture of the median investor as unsophisticated and somewhat aware of his limitations when managing a DC retirement account, but they have little to say about people who have a DB retirement account, in which case the investment decisions are made for them. Samwick and Skinner (2004) and Poterba et al., (2007) argue that, in the US, DC plans would be preferable to DB plans for everyone but the most risk-averse people, even though DC plans are more risky and more likely to end up yielding extremely low pensions. Their model assumptions and their data, however, do not account for the fact that the lower risk offered by DB plans allows households to take more risk and improve their returns on their own asset portfolios, which could increase their retirement wealth. Our results show that people are able to identify the risk in DB pension funds, and hold more equity and less cash when their pension risk is low.

Our findings contribute to the literature on background risk and its effects on individual decision-making by providing empirical evidence of the influence of DB pension risk on individual portfolios. Formal models of the effects of background risk on individual decisions can be found as early as Pratt and Zeckhauser (1987) and Gollier and Pratt (1996), whereas models that calibrate the effects of background risk on individual portfolios appear as recently as Heaton and Lucas (2007).[1] However, these studies tackle the issue of background risk by calibrating models with different kinds of market frictions and tradable and non-tradable risks, whereas we directly observe the decisions of individuals facing such risks. Curcuru et al., (2010) provides evidence of the effects of some types of background risk on individual portfolio allocation, and briefly addresses pension risk by showing that participating in a DB plan essentially has no effect on stock ownership. However, they only have a crude measure of

[1] See Heaton and Lucas (2007) for an extensive review of the literature on background risk and portfolio choice.

pension risk (having a DC or DB plan) and since they are not focus on pension-related background risk specifically, they pay no further attention to it. We focus on the financial behavior of households who face measurable DB pension risks. In that sense we provide the first study on the extent to which households "trade away" pension risk using their individual portfolio and labor supply.

The remainder of the paper is structured as follows. Section 2 explains the Dutch pension system and introduces our measure of DB pension risk. Section 3 describes our data and our empirical methodology. Section 4 presents our results. Section 5 concludes.

2. DEFINED BENEFIT PENSION RISK AND THE DUTCH PENSION SYSTEM

Dutch occupational pension plans provide a good example of so-called hybrid DB plans in which pension benefits are based on wages, as in traditional DB plans, but benefits are no longer unconditional; they explicitly depend on financial market developments and demographic changes.

The capitalization of Dutch occupational pension funds is among the largest worldwide (2012: XXX% GDP; …). Where many countries have witnessed a shift from traditional DB to DC plans, this has hardly been the case in the Netherlands. One of the reasons for the success of the Dutch occupational pension system is the willingness both employers' and employees' organizations to adjust the traditional DB pension scheme to changing circumstances (Sleijpen, ….). This goes back to 2003, following the "dot com" crisis, which eroded the value of pension fund assets. After this crisis, it was decided to renege on final-pay schemes in favor of average-wage DB schemes; benefits are no longer related to the end-of-career salary, but the pension plan participant now accrues benefits on the basis of his average income throughout his career. A second reason for success was the indexation of pension accruals and benefits to prices or wages dependent on the financial position of the pension fund. This financial position of pension funds is measured through the funding ratio: the value of the fund's assets divided by the value of its pension liabilities.

The changes in pension plan conditions, as agreed upon by employers and employees, were enshrined in legislation in 2006 with the introduction of the Pension Law 2007. This law introduced a

number of changes in pension fund regulation. First, it introduced market valuation of assets and liabilities.[2] Second, it provided the possibility to cut pension benefits and accruals if 1) the funding ratio drops below 105 percent—the minimum required funding ratio[3]—and does not recover after three years, and 2) if other recovery measures cannot be resorted to ("ultimum remedium").[4] Third, it stipulated that pension funds should hold (solvency) reserves that depend on the riskiness of the pension fund's asset mix. The reserve requirement, operated through the so-called required funding ratio, was calibrated at 130% for the average Dutch pension fund using a standard solvency model.[5] Currently, the average required funding ratio amounts to approximately 125% (DNB, ….).[6]

The policy of most Dutch pension funds regarding contributions and indexation is based on so-called policy ladders (Ponds, ….). The policy ladders describe the way that contribution rates and indexation rates deterministically depend on the funding ratio. A typical indexation policy ladder is shown in Figure 1, where there is no indexation below a funding ratio of 105%. Full indexation is provided once the funding ratio reaches 130% or higher. Typically, full indexation is provided when the funding ratio is above the required reserve ratio, and at that point indexation that has not been provided in the past can be restored and, thereafter, contribution rates can be reduced.[7] The latter is legally only possible when the real funding ratio is 100% and after indexation has been fully restored.[8]

[INSERT FIGURE 1 ABOUT HERE]

[2] Since the Pension Law 2007, pension liabilities have been valued using the risk-free market interest rates reflecting their duration. In practice, swap rates are used as a proxy for risk-free interest rates.
[3] Following the so-called IORP Directive ….
[4] Due to the financial crisis it was decided in 2008 to temporary extend this 3-year recovery period to 5 years. Nevertheless it is necessary for a number of Dutch pension funds to reduce its benefits and accruals (DNB, 2013).
[5] The standard solvency model assumes a 2.5% probability of a pension fund being underfunded in a one-year horizon.
[6] The financial crisis has triggered a recalibration of the standard solvency model, which most likely will enter into force on 1 January 2015. For the average Dutch pension fund this recalibration will lead to an increase in the required funding ratio of approximately 5 percentage points (DNB, ….).
[7] In some cases full indexation is only provided if the actual funding ratio is above 100%, measured in real terms. This is roughly equivalent to a nominal funding ratio of 130% to 140%.
[8] See previous footnote.

In the Dutch context, the actual funding ratio relative to the required funding ratio is a good measure of the perceived DB pension risk. If this ratio is 1 or higher, the financial position of the fund is comfortable and full indexation of pension benefits and accruals is not at doubt. The perceived riskiness of the pension fund is low, from the point of view of the pension plan participant. The reverse is true when the ratio of funding ratio to required funding ratio is lower than 1. In that case there is no, or only partial, indexation, and there might even be a risk of cutting pension benefits and accruals. In that case, the perceived riskiness of the pension fund is high.

Another reason for the success of the Dutch pension system is compulsory participation (Sleijpen, ….). Every worker is compelled to participate in the occupational pension plan of his employer. Moreover, most employers are compelled to adopt pension plans which are shared by all employers of a given sector of industry. The result of this compulsion is a very high participation of workers in occupational pension funds, also from an international perspective (OECD, ….). Hence, the replacement ratio of the Dutch pension system is also relatively high (OECD, ….). The drawback of this compulsion is that plan members have no possibility to opt out, even when their pension fund is performing poorly. For the purpose of this paper, this is an interesting feature of the Dutch pension system, as mentioned in the Introduction.[9] If plan members cannot "vote with their feet", they have to resort to other measures to change their risk exposure if their pension fund does not deliver. They can, for instance, change their private pension savings (i.e., in the third pillar of the pension system), but they can also change the asset allocation of private savings and investments, and they can even adjust their labor supply. The latter two behavioral responses will the focus of this paper.

3. DATA AND METHODOLOGY

The DNB Household Survey (DHS)

[9] This feature does not mean that our analysis is exclusive to The Netherlands. Our results will apply to any legislation in which the costs of switching pension funds (either monetary, legal, or in terms of time) are large enough that people would rather re-optimize their individual portfolios to adjust for their pension fund risk. Considering the recent decrease in the costs of equity investments and the complexity involved in changing pension funds, this is true for most DB pension funds.

Our main source of data is the Dutch Central Bank Household Survey (DHS), an internet survey of a representative panel of Dutch households collected by CentERdata since 1993. The DHS currently surveys around 2,000 Dutch households each year and when necessary CentERdata provides the participating households with an internet connection, a television set, and a set-top box for the television so they can answer the survey. Within each household, all persons aged 16 or over are asked to answer. For this study we make use of the waves of 2007 through 2011.

In this paper we focus on two broad asset classes: Equity and cash. Equity is the sum of direct stockholdings, mutual funds, and options. Cash is the sum of checking, saving, and deposit accounts. Together, these two asset classes add up to 86 percent of the financial wealth of the average household in our sample. The remaining assets (which we do not explicitly analyze) are government and municipal bonds, mortgage bonds, illiquid saving certificates, and other unspecified investments and savings. We define total financial wealth as the sum of all three asset classes described above.

To analyze the decision to hold *some* equity, or to hold *all* financial wealth in cash—the extensive margins in portfolio choice—, we create two dummy variables; one that takes the value of one if a person owns equity, and another one that takes the value of one if a person holds *all* financial wealth in cash.[10] For the extensive margin in labor supply we create a dummy variable that takes the value of one if a person is planning to retire early.

To analyze individual portfolio holdings in equity and cash—the extensive margins— we look at the share of total financial wealth invested in equity, and the share invested in cash. The share in equity has an empirically relevant bound at zero, while the share in cash has a relevant bound at 100. For the extensive margin in labor supply we take the expected retirement age of

[10] Note that there two dummies are not simply the reverse of each other, since individuals can also hold wealth in the remainder asset class (government and municipal bonds, mortgage bonds, illiquid saving certificates, and other unspecified investments and savings), which is neither equity nor cash.

the respondents. All the control variables used throughout this paper are also taken from the DHS.

Summary statistics of the most important variables for our analyses are presented in Table 1 for the DHS waves of 2007 through 2011 and for our estimation sample. The estimation sample is similar to the DHS sample in most respects. However, the estimation sample is slightly wealthier and older, which in turn results in an underrepresentation of self-employed and unemployed people and an overrepresentation of married people and retirees. These small selectivity issues are unlikely to cause problems in our analyses.

[INSERT TABLE 1 ABOUT HERE]

The pension fund performance data

As mentioned above, we measure the riskiness of each DB pension fund by taking the ratio of their actual funding ratio to their funding ratio as required by the Dutch Central Bank. To match these data to the DHS, we make use of survey question that asks the name of the pension fund to which each person contributes. To retirees, the questionnaire asks from which pension fund they receive benefits. In the estimation sample there are 31 different pension funds to which people contribute. We use the names of these pension funds to match the individual survey data with the actual funding and the required funding for each pension fund for 2007 through 2011, as determined by the solvency model mentioned in Section 2. From this information we construct our measure of DB pension fund risk, our main regressor, by taking the ratio between the actual funding and the required funding for each fund in each year. For brevity and for clarity, we will refer to this variable throughout the paper as the *ATR funding*.

Figure 2 shows the distribution of *ATR funding* for both the entire sample of individual observations and the sample of pension funds we observe in the data. The figure shows

significant variation in the individual exposure to DB pension fund risk. A large part of the observations fall below one, meaning that the actual funding is below the required funding. An analysis of the changes in the distribution of *ATR funding* over time shows that in 2007 most funds' actual funding exceeded their required funding, but from 2008 onwards this pattern was reversed due to the financial crisis. In 2011 the average actual funding still fell short of the average required funding. The differences between both distributions in Figure 2 arise because people are not evenly distributed across the pension funds we observe. People contributing to the riskier funds (those with *ATR funding* below one) are more prominent within our data. However, we do not think this causes any problem with our identification strategy since the distribution of pension fund risk as perceived by individuals (left) maintains the general right-skewed shape of the risk distribution of the pension funds in our sample (right). Moreover, there are enough individual observations to identify the effects of pension risk throughout the relevant range of risk values.

[INSERT FIGURE 2 ABOUT HERE]

Econometric framework

Our main analysis is based on six different empirical models. We use probit models to analyze the effect of pension fund risk on the decision to invest in equity, to hold all financial wealth in cash, to retire early. We use Tobit models to analyze the effect of pension fund risk on individual portfolio shares in equity and cash and on the expected retirement age. The Tobit models account for left censoring at zero for the equity share (2,177 observations), right censoring at 100 for the cash share (2,111 observations), and right censoring at 99 for the expected retirement age (184 observations). To ease the interpretation of our results, in all

tables below we report Average Marginal Effects—which, for conciseness, we will refer to as "effects" throughout—on the probability of a positive outcome (for probit models) and the censored expected value (for Tobit models).

In every regression we control for wealth (in the form of the log of wealth in durable assets and a dummy for home ownership), income, age, education, gender and family composition. These controls are common to the literature on portfolio choice (e.g., Rosen and Wu (2004); Hong et al., (2005); Guiso et al., (2008)). We also include a measure of willingness to take risk, which is also an important determinant of portfolio choice. We control for differences in labor market status through dummy variables for self-employment, unemployment and retirement. Finally, we include a set of year and pension fund dummies. This means that the coefficient of our pension fund risk measure is identified solely through within-pension fund variation.[11]

An important estimation issue is the calculation of the standard errors in our regressions. Since our main regressor, *ATR ratio*, has the same value within a given year and fund for every person, ordinary calculations of the standard errors of our effects could suffer from a downward bias (Moulton, 1990). To account for this we use robust standard errors for all the effects reported, clustered at the pension fund level. The statistical significance of our main results also remain if we use the bootstrap-t procedure of Cameron et al., (2008) on the Average Marginal Effects of this study.

4. RESULTS

The effects of pension fund risk

Table 2 shows how pension fund risk is related to both the intensive and the extensive margin of individual portfolio allocations to equity and cash. The marginal effect of *ATR*

[11] Our main results are robust to various alternative specifications, with and without pension fund and year dummies.

funding is positive for the decision to hold equity, and negative for the decision to hold all financial wealth in cash only. The results are consistent with diversification of pension fund risk using the extensive margins of individual portfolios.

ATR funding is also positively related to the share of financial wealth held in equity, and is negatively related to the share held in cash. This suggests that people also diversify their pension risk by holding less equity and more cash in their individual portfolios—the intensive margin. Labor supply, as measured by the extensive and the intensive margin in retirement age, is not affected by pension fund risk.

The effects of pension fund risk on individual portfolio allocation are economically important. The standard deviation of *ATR funding* in the sample is 0.16, meaning that the economic impact of a one standard deviation increase in *ATR funding* can be estimated as 0.16 times the size of the marginal effect reported in Table 2. For example, a one standard deviation increase in *ATR funding* would, on average, be related to a 9 percentage point increase in the probability of owning equity (0.16*0.565), and a 4.5 percentage points increase in the equity share of total financial wealth (0.16*28.505). These effects are roughly comparable to the marginal effect of having university education versus unfinished high school, or of being a home-owner versus renting. To give our findings even more perspective, note that the average *ATR funding* for the pension funds in our sample decrease from 1.22 in 2007 to 0.88 in 2008 due to the financial crisis. Our estimates indicate that this increase in pension fund risk due to the crisis would have corresponded, *ceteris paribus*, to a decreased probability of owning risky asset by roughly 19 percentage points, and would have decreased the equity share of total wealth by about 10 percentage points.[12] Clearly equity holding did not suffer as much as

[12] The effects, as estimated here, assume that the effect of pension fund risk on individual portfolio holdings is linear. We do not investigate non-linearities in the effect of pension fund risk, which would lead to more precise and likely less severe estimates.

suggested solely by these numbers, but it is noteworthy that between 2007 and 2008 the unconditional equity holding in the DHS decreased by about 10 percent (or 2.2 percentage points), and the wealth share in equity decreased by about 15 percent (or 0.7 percentage points).

Table 2 further shows the effects of other socioeconomic variables on individual portfolio and expected labor supply decisions. University education increases investment in equity and decreases investment in cash, consistent with fixed information and cognitive costs of investment. Wealth in durable assets and home ownership increases investment in equity, and decreases investment in cash and expected labor supply. This is consistent with investment in equity increasing with wealth, and with housing being treated as a risk-free asset by individuals. It also shows that wealthier individuals with home equity can afford to retire earlier. Willingness to take risk affects portfolio choice in the expected way, and it has minor effects on labor supply, suggesting that early retirement might be seen as a risky choice. Income has only weak effects on portfolio choice, but is a strong predictor of labor supply. This is consistent with the wealth effects discussed above, and again shows that people are more willing to retire early when they are doing well financially. Age has a positive effect on equity investment and a negative effect on cash investment. These effects are not due to the limited functional form in which age enters the estimation; we confirm the age effects in unreported analyses using quadratic and cubic polynomials, and non-parametric regressions. This result is inconsistent with lifecycle portfolio theory studies that predict that individuals will take less financial risk as they age (e.g., Bodie, Merton, and Samuelson (1992)). However, several empirical studies also show positive age effects in equity holding and the share of wealth in equity (e.g., Donkers and van Soest (1992), Poterba and Samwich (2001), Kaustia and Torstila (2011), van Rooij, Lussardi, and Alessie (2011)). Gender and marital status only affect the early retirement decisions in a way consistent with common retirement differences in gender and with negative

effects of spousal income on retirement decisions. Retirement decreases equity investments and increases cash investments.

[INSERT TABLE 2 ABOUT HERE]

Identification through heterogeneous effects

We have shown that DB pension fund risk has an important effect on individual portfolio allocations to equity and cash, as well as on expected early retirement. Since all our regressions include both year and pension fund fixed effects, we identify this effect using only the within-pension fund variation in *ATR funding*. Moreover, we control for a rich set of characteristics in all our regressions. Still, one might ask whether *ATR funding* is correctly identifying pension fund risk, or whether its effects are just being driven by correlated unobservable characteristics. In this section we present various heterogeneous effects of pension fund risk that support the identification of our main results and provide some information on their drivers.

For pension fund risk to affect individual behavior, people have to be aware that such risk exists. Therefore, if our hypothesis is correct, we should not observe any effect of *ATR funding* for those who are unaware of their pension risk. We test this theory using a question in the DHS that asks: *"A pension plan can include an arrangement for correcting the pension that can be claimed and/or the pension that is actually being paid according to a price-index and/or to a salary-index. Pensions that are corrected in this way are called indexed to inflation. Is your (future) retirement pension indexed to inflation?"* Answering either "yes" or "no" to this question suggests respondents' awareness of pension risk, whereas answering "I don't know" suggests that the respondent is unaware of pension risk. Pension-risk-aware people should therefore show stronger portfolio and labor supply reactions to pension fund risk than pension-

risk-unaware people.[13] Based on this intuition, we construct a dummy variable for pension awareness and calculate the heterogeneous effects of *ATR funding* on this dummy via an interaction term. The corresponding effects for pension-risk-aware and pension-risk-unaware people are presented in the upper panel of Table 3.

The results show that the mean effects of pension risk are mainly driven by pension-risk-aware people. The impact of *ATR funding* on equity investment (on both the extensive and the intensive margin) and cash investment (on the intensive margin) are stronger for the pension-risk-aware. In addition, pension risk also has a negative impact on the expected retirement age for the pension-risk-aware, which is also consistent with people choosing to retire earlier when their pension savings are less risky. All these evidence supports the hypothesis that it is indeed pension fund risk driving our results and not some other variable.

Further support for the identification of our main results can be found by looking at the behavior of retirees. As mentioned above, Dutch law tied the inflation indexation policy of the benefits paid to retirees to the funding of pension funds. Since pension income is naturally a more important source of income for retirees than it is for employed people, retirees should react more sharply to changes in pension fund risk by rebalancing their portfolios. We test whether this is the case by calculating the effects of *ATR funding* on equity and cash investments for employed people and for retirees separately.

The results, presented in the second panel of Table 3, show that pension fund risk has a significantly stronger impact on the portfolio decisions of retirees. These results again support pension risk as the true source of our main findings.

[INSERT TABLE 3 ABOUT HERE]

[13] About 74 percent of our estimation sample are aware of the indexation status of their pension funds.

We also calculate the age and wealth profiles of the effects of pension risk. The age profile of the effects, shown in Figure 3 is again supportive of our hypothesis. For young people, *ATR funding* has no impact on their portfolio choice or their early retirement expectations. However, for older people—starting around 55 years old—the effects become significant and they become increasingly larger. This suggest that people only react to pension risk once they have been working for a while, have some wealth, and start approaching an age in which retirement planning becomes pressing.

The wealth profile answers a different question: Is everyone able to adjust their individual portfolios in response to pension risk? With the cost of investing in equity being so low now, one would expect so. However, Figure 4 indicates otherwise. Figure 4 shows that people with little wealth do not respond to pension risk by purchasing equity or rebalancing their portfolios. Only after people have accumulated wealth exceeding roughly 12,000 Euro ($e^{2.5} * 1{,}000$) do they begin to react to pension risk through investment decisions.[14] The wealth pattern in early retirement expectations is less dramatic, suggesting that people adjust their expected labor supply (if they do at all) in a similar way regardless of their wealth. These findings are all consistent with fixed monetary costs for portfolio investments but no monetary costs for changes in expected labor supply.

[INSERT FIGURES 3 AND 4 ABOUT HERE]

[14] Economic theory provides no clear intuition of what we should expect regarding the age and wealth patterns of the effects of pension risk on portfolio decision and labor supply. On one hand, for wealthier and younger people pension wealth is a relatively more important since pension wealth is often constructed from deductions from the gross salary, and people also have not had time to accumulate other assets. On the other hand, monetary and information costs of building and keeping a portfolio are more binding for younger and less wealthy people, and portfolio reactions are possible only after those constraints are lifted. Moreover, older people (approaching retirement age) should be more aware of pension risk and therefore react to it more. Our interpretation of the evidence implies that the latter effects are stronger than the former.

5. CONCLUSIONS

In this paper we show that individuals react to pension risk by rebalancing their individual portfolios. This result is consistent with DB pension risk acting as a background risk that people cannot directly eliminate, but that can be "traded away" through individual portfolios. An increase in pension risk decreases both the probability to hold equity and the share of wealth invested in risky assets, and increases the probability to hold all financial wealth in cash, as well as the share of wealth in cash. The effects are mostly driven by people who are more likely to be aware of their pension risk (i.e., those who reported knowing about the indexation policy of their pension funds), retirees, and people approaching retirement age. Those aware of their pension fund risk also increase their expected labor supply—as measured by their expected retirement age—when their pension savings are at risk. Portfolio rebalancing because of pension risk only takes place after individuals have accumulated a moderate amount of total wealth.

The recent literature on retirement portfolio choice states that people are ill-equipped to make proper decisions about their retirement, and that they have a preference for DB-type retirement plans. Even so, Poterba et al., (2007) argue that going for DB plans are the wrong choice for most people, since DC plans provide better retirement conditions in almost every case. Our results contest this hypothesis. People with DB pension plans appear to adjust their individual portfolios based in their pension risk by holding more equity, less cash, and working less when their pensions are safer. This suggests that people indulge in their preference for high-return assets in their individual portfolios, even if they cannot do it in their pension portfolios. A well-funded DB pension system would therefore allow people searching for higher returns to obtain them through their individual portfolios, while unburdening the less sophisticated investors with the portfolio decisions entailed in a DC system.

A finding that we consider somewhat puzzling is the fact that people begin to take pension risk into account for portfolio rebalancing only when they are relatively wealthy. Since pension wealth is the

most important component of overall wealth for less wealthy people, we expected those people to react more elastically to pension risk. Of course, this finding can be explained by fixed costs—either monetary or of information—of entering the stock market. However, in recent years the monetary cost of investing in equity has decreased sharply, and currently most retail banks offer investment accounts that can be opened at virtually no cost and be managed without even going into the bank's office. The other likely explanation for the wealth heterogeneity in the effects of pension risk is then information costs. These costs can be easily alleviated by employers, via simple measures such as offering to open an investment account upon employment, or organizing investment advice sessions for their employees.

Our paper leaves open several avenues for future research. While we show that people adjust their equity and cash holdings when exposed to pension risk, we are agnostic about their specific equity allocations. To accurately measure the trade-off between DC and (hybrid) DB pensions, it would be useful to estimate a structural model of individual portfolio choice, retirement portfolio choice, and labor supply. By fixing the choice of retirement portfolio assets exogenously, we could see the specific role of DB pension risk on cross-category asset allocation. It would also be useful to model labor supply in a more flexible way, not only through the retirement age and the early retirement decision but also through part-time employment or even through effort supply at work.

A second important point in the future research agenda is to determine whether it is beneficial to make pension risk data more accessible to the public. On one hand, if this data is easier to find, individuals will have a clearer picture of their overall risk exposure and will be able to manage their portfolios in a manner that reflects their willingness to take risk. On the other hand, pension risk could become too salient and cause people to excessively rebalance their portfolios and incur in unnecessary costs that will harm their retirement wealth. More research into this area could benefit current pension contributors and retirees greatly.

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TABLE 1: SUMMARY STATISTICS OF THE MAIN VARIABLES FOR THE DHS 2007-2011 OBSERVATIONS AND THE ESTIMATION SAMPLE

	DHS 2007 - 2011			*Estimation sample*		
	Obs.	*Mean*	*Std. Dev.*	*Obs.*	*Mean*	*Std. Dev.*
Holds equity	5,779	0.21	0.41	2,958	0.26	0.44
Holds all wealth in cash	5,779	0.76	0.42	2,958	0.71	0.45
Equity share of wealth	5,779	8.97	22.09	2,958	10.47	22.87
Cash share of wealth	5,779	89.19	24.81	2,958	87.41	25.43
Plans to retire early	3,290	0.33	0.47	1,678	0.45	0.50
Expected (early) retirement age	3,341	70.51	13.80	1,706	66.84	10.58
Total wealth (1,000 Euro)	7,003	51.06	153.86	2,958	63.10	148.92
Total durable assets value (1,000 Euro)	6,841	16.09	88.27	2,958	17.86	65.61
Lives in own house	15,105	0.79	0.41	2,958	0.77	0.42
High school degree	15,054	0.39	0.49	2,958	0.33	0.47
University or college degree	15,054	0.30	0.46	2,958	0.46	0.50
Gross income (1,000 Euro)	5,700	27.03	24.85	2,958	35.17	20.07
Age	14,321	47.57	17.44	2,958	55.81	13.89
Female	15,105	0.53	0.50	2,958	0.39	0.49
Married	15,111	0.52	0.50	2,958	0.73	0.45
Willingness to take financial risk	6,476	2.70	1.03	2,958	2.61	1.01
Number of people in household	15,105	2.94	1.31	2,958	2.37	1.16
Self-employed	15,105	0.06	0.24	2,958	0.01	0.09
Unemployed	15,105	0.02	0.13	2,958	0.01	0.09
Retired	15,105	0.16	0.36	2,958	0.33	0.47

TABLE 2: THE MAIN EFFECTS OF PENSION FUND RISK ON HOUSEHOLDS PORTFOLIO HOLDINGS AND LABOR SUPPLY

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Dependent variable =	*Holds equity*	*Holds only cash*	*Plans to retire early*	*Equity share*	*Cash share*	*Exp. retirement age*
ATR funding	0.565**	-0.416*	0.225	28.505***	-21.650*	-7.905
	(0.237)	(0.234)	(0.375)	(10.709)	(11.680)	(7.144)
High school degree	-0.012	0.005	-0.064*	-1.348	0.434	0.152
	(0.037)	(0.043)	(0.033)	(1.535)	(2.091)	(1.219)
University or college degree	0.081**	-0.090**	-0.093***	3.114*	-3.958*	0.303
	(0.038)	(0.042)	(0.022)	(1.853)	(2.115)	(0.726)
Log of durable assets	0.009***	-0.013***	0.009***	0.291***	-0.547***	-0.148**
	(0.002)	(0.002)	(0.003)	(0.102)	(0.114)	(0.061)
Lives in own house	0.095***	-0.096***	0.115***	4.412***	-4.955***	-2.625***
	(0.025)	(0.026)	(0.036)	(1.072)	(1.304)	(0.637)
Willingness to take financial risk	0.123***	-0.117***	0.014*	5.964***	-6.226***	-0.191
	(0.010)	(0.007)	(0.008)	(0.507)	(0.400)	(0.258)
Log of income	0.015	-0.018*	0.094***	0.559	-0.630	-3.595***
	(0.010)	(0.010)	(0.019)	(0.456)	(0.541)	(0.422)
Age	0.005***	-0.006***	0.003***	0.296***	-0.367***	0.080***
	(0.001)	(0.001)	(0.001)	(0.047)	(0.058)	(0.024)
Female	-0.016*	0.016	0.083**	0.062	0.037	0.010
	(0.010)	(0.010)	(0.032)	(0.473)	(0.632)	(0.692)
Married	0.007	-0.012	0.169***	-0.136	-0.149	-0.633
	(0.026)	(0.026)	(0.022)	(0.972)	(1.148)	(0.678)
Number of people in household	-0.005	0.001	-0.001	-0.231	0.070	-0.455***
	(0.007)	(0.006)	(0.007)	(0.280)	(0.282)	(0.154)
Self-employed	-0.162	0.187	-0.026	-7.921	9.648	0.479
	(0.117)	(0.123)	(0.129)	(4.995)	(6.034)	(3.127)
Unemployed	-0.003	-0.050	-0.081	-0.377	-1.862	4.119
	(0.094)	(0.088)	(0.119)	(4.428)	(4.349)	(2.881)
Retired	-0.102***	0.113***		-4.756***	5.868***	
	(0.023)	(0.022)		(1.000)	(1.087)	
Year Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Pension fund fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,958	2,958	1,811	2,958	2,958	1,817

*Columns (1), (2), and (3) report Average Marginal Effects of probit models. Columns (4), (5), and (6) report Average Marginal Effects of Tobit models. Standard errors clustered at the pension fund level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1*

TABLE 3: HETEROGENEOUS EFFECTS OF PENSION FUND RISK BY RETIREMENT STATUS AND PENSION INDEXATION KNOWLEDGE

	Extensive margin			*Intensive margin*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Dependent variable =	*Holds equity*	*Holds only cash*	*Plans to retire early*	*Equity share*	*Cash share*	*Exp. retirement age*
			Effect of ATR Funding for:			
Uninformed about pensions	0.443*	-0.338	0.108	20.053**	-15.054	-7.972
	(0.230)	(0.240)	(0.355)	(10.146)	(11.510)	(5.917)
Informed about pensions	0.622**	-0.453*	0.249	32.131***	-24.643**	-15.879***
	(0.246)	(0.240)	(0.409)	(11.125)	(12.057)	(5.865)
Observations	2,958	2,958	1,811	2,958	2,958	1,847
Difference test (p-value)	0.006	0.227	0.305	0.001	0.065	0.003
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
			Effect of ATR Funding for:			
Employed	0.502**	-0.352	-	24.477**	-17.612	-
	(0.238)	(0.237)		(10.233)	(11.180)	
Retired	0.771***	-0.630**	-	40.193***	-33.761**	-
	(0.282)	(0.277)		(14.025)	(15.064)	
Observations	2,958	2,958	-	2,958	2,958	-
Difference test (p-value)	0.040	0.018	-	0.024	0.011	-

*The effects of the first panel are derived from probit and Tobit regressions that interact a dummy that takes the value of 1 if the respondent is aware of the current indexation policy of his pension fund with ATR funding. The effects of the second panel are derived from probit and Tobit regressions that interact a dummy that takes the value of 1 if the respondent is retired with ATR funding. Naturally, for the second panel the equations (3) and (4) are not identified. The table reports the Average Marginal Effects of probit models (Columns (1) through (3)) and Tobit models (Columns (4) through (6)). All regressions include the same control variables reported in Table 1, and also include year and pension fund fixed effects. Standard errors clustered at the pension fund and year level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1*

FIGURE 1: THE TYPICAL INDEXATION POLICY LADDER OF A DUTCH PENSION FUND

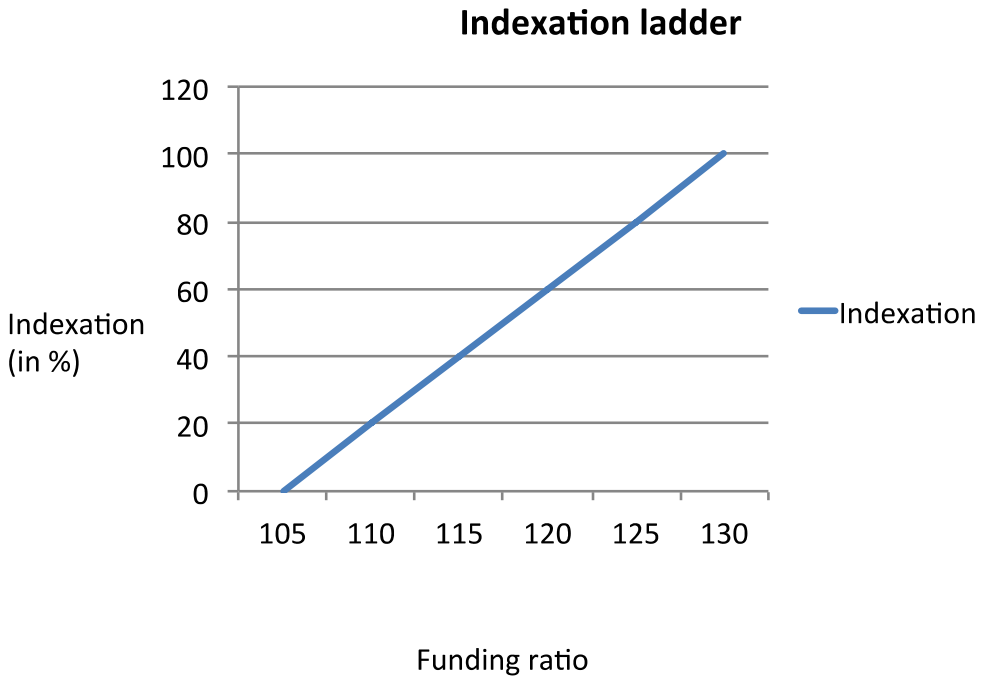


FIGURE 2: THE DISTRIBUTION OF PENSION FUND RISK (ACTUAL FUNDING DIVIDED BY REQUIRED FUNDING) FOR INDIVIDUALS AND FOR PENSION FUNDS IN SAMPLE

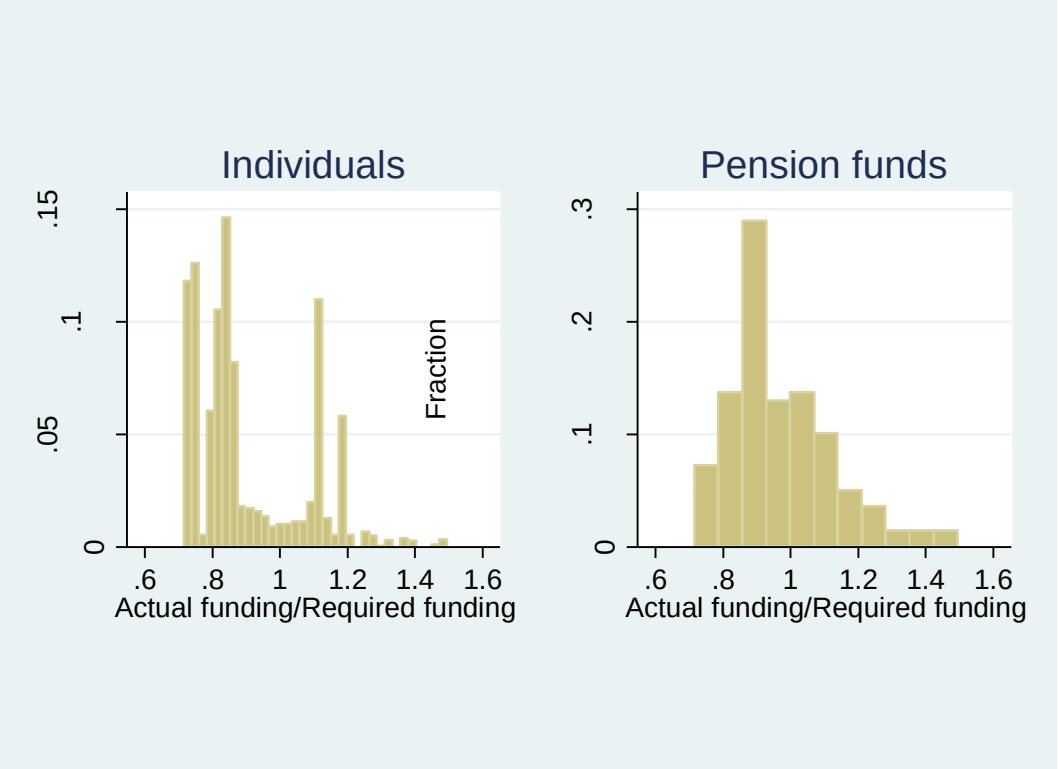
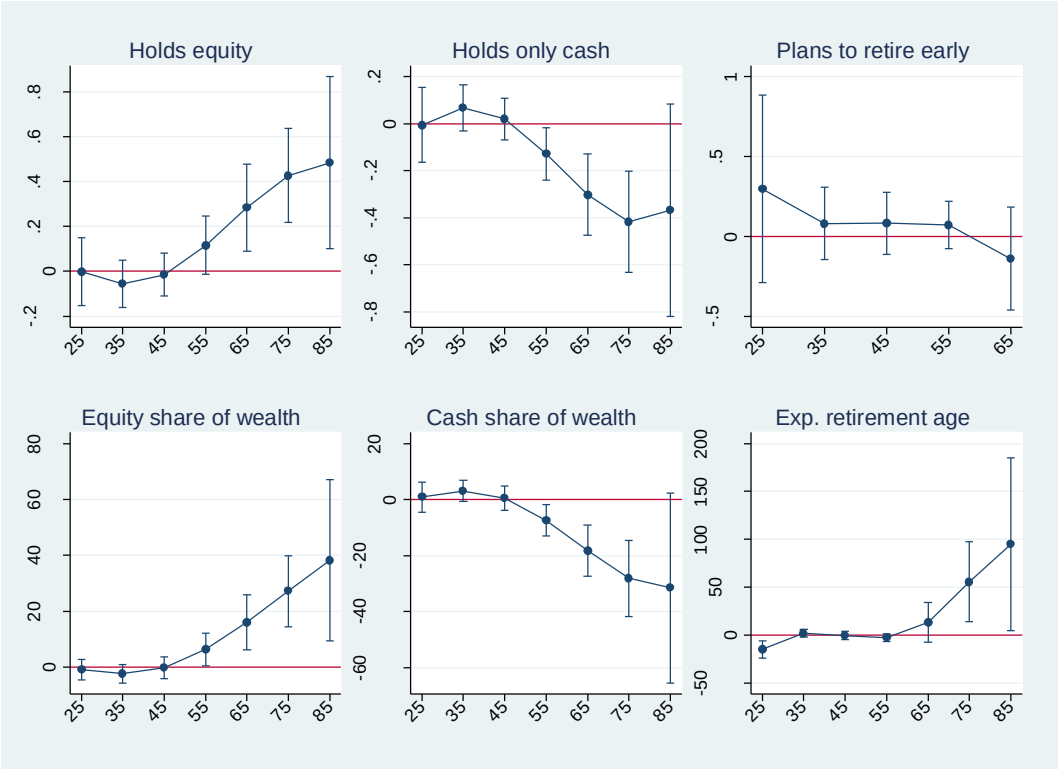
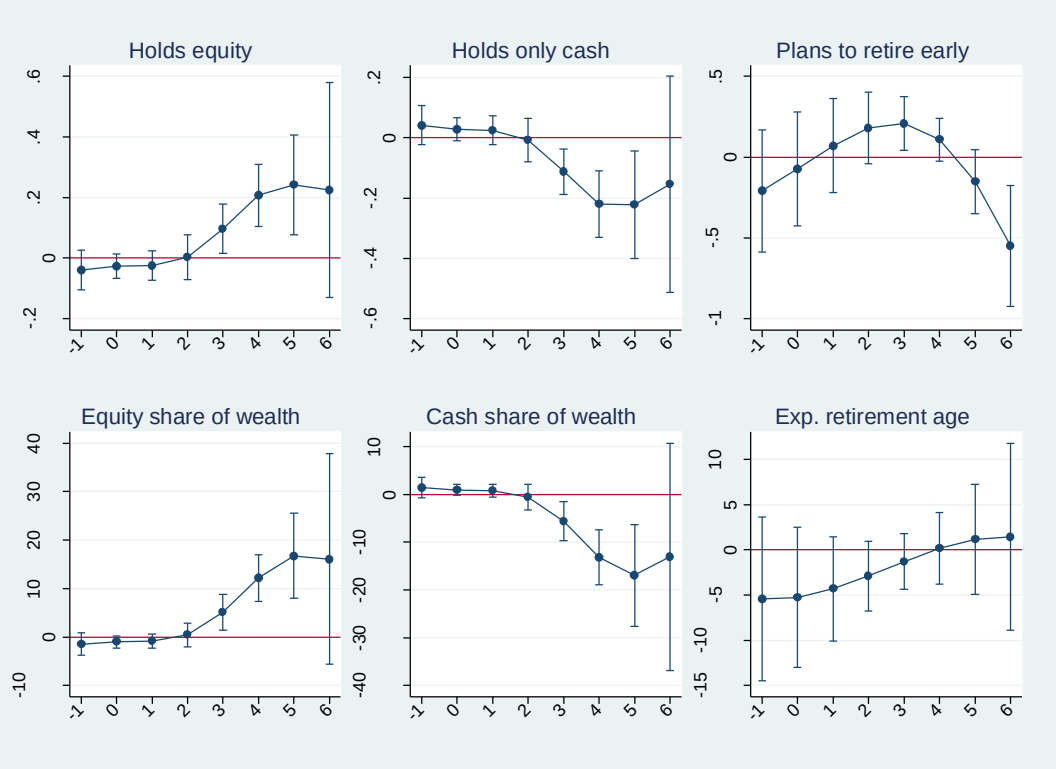


FIGURE 3: HETEROGENEOUS EFFECTS OF PENSION FUND RISK BY AGE[15]



[15] These graphs are calculated from regressions similar to Table 1 that include a cubic polynomial of age interacted with *Actual funding/Required funding*. The Average Marginal Effects of the variable are then evaluated at several points in the age distribution. The size of the Average Marginal Effects is on the vertical axis, and age is on the horizontal axis.

FIGURE 4: HETEROGENEOUS EFFECTS OF PENSION FUND RISK BY (LOG) WEALTH[16]



[16] These graphs are calculated from regressions similar to Table 1 that include a cubic polynomial of the log of total wealth (including financial, durable, and real estate wealth) interacted with *Actual funding/Required funding*. The Average Marginal Effects of each variable are then evaluated at several points in the log wealth distribution. The size of the Average Marginal Effects is on the vertical axis, and log total wealth is on the horizontal axis.