Determinants of corporate pension fund risk-taking strategy in the Netherlands

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Pension plans in the Netherlands can be classified into 3 groups; DC, DB and hybrid. In the Netherlands, increasingly more pension plans transform from DB to hybrid. Corporate pension funds take risk in order to grow their assets with the goal to continuously be able to pay their liabilities. The aim of this research is to investigate what explains the mismatch risk for hybrid and DB corporate pension funds in the Netherlands.

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Keywords
Investment policy, pension beta, asset-liability management, pension fund, risk mismatch

9th IBA Bachelor Thesis Conference, July 5th, 2017, Enschede, The Netherlands.

1. INTRODUCTION

The number of total assets for all pension funds in the Netherlands is astounding. At the end of 2016, the total assets were estimated at roughly 1370 bn euro according to the DNB (DNB, Balans van pensioenfondsen). This is more than twice the countries' GDP. This means that a big amount of capital is mobilized in order to pay out the benefits to retirees who themselves have been contributing to a pension fund while they were working. The risk which pension funds take is an important variable which influences the financial part of the retirement for all inhabitants of the Netherlands who have worked. Consequentially any new insight in the process of how variables influence the risk-taking strategy is of high importance.

Pension funds in the Netherlands need to balance their assets and liabilities consistently with Asset Liability Management (ALM) in order to minimize the risk of not being able to pay out the benefits because of a low funding ratio. The strategic allocation of assets plays an important part in the management of a pension fund. The distribution of capital is bound by regulations established by the DNB. The pension funds are required by Dutch law to take into account their liabilities and not just maximize the return on assets. With mean-variance optimization the highest return on assets could be achieved, but liabilities would be neglected. This is an unhealthy situation and thus pension funds are required to balance their ability to consistently meet their obligations and their need to generate returns.

In previous research about what influences risk exposure has shed some light on determinants. However, the variables used to model risk taking differ significantly between regions used in the research. In the US, the emphasis for variables lies on tax benefit, financial slack, accounting (An, Huang & Zhang, 2013; Mohan & Zhang, 2013). While for research done in the Netherlands other variables are used such as maturity and personal wealth (Bikker et al, 2009; Gorter & Bikker, 2011). The funding ratio and size are used in both countries.

Not all variables which are used elsewhere are applicable in the Netherlands at first sight, but some seem to fit in. The parameters used to measure risk-taking strategy is rather different as well. In the US, the pension beta is used, with the reasoning that the consolidation of asset beta and liabilities beta reflects the ultimate objective; meet liabilities. In the Netherlands, the dependent variable for risk-taking often is equity percentage per class, which neglects the size and risk characteristics of liabilities (An, Huang & Zhang, 2013). This leads to a research gap in relation to the potential available variables to be explored in the Netherlands.

The purpose of this paper is to combine previous work on pension fund risk-taking behavior from several countries in order to contribute to the academic understanding of pension fund risk-taking strategy. This leads to the research question: What are determinants for corporate pension fund risk-taking strategy in the Netherlands?

Risk strategy is measured in this thesis as mismatch risk. The mismatch risk is the pension beta, which is a measure for the mismatch between a plans assets risk and liabilities risk, scaled by the plan sponsor. A larger pension beta (risk mismatch) means that if there is a change in underlying risk factors, plan assets and liabilities will change by different amounts. This results in a bigger gap between plan assets and liabilities.

The paper will proceed as follows: Section 2 is based on a profound review of available literature on investment policy and thus accommodates the development of hypotheses. After this the construction and measurement of necessary variables is clarified in section 3. In section 4 the data is presented and in section 5 and 6 empirical results and robustness checks can be found. Section 7 and 8 conclude this research and discuss the limitations and implications. References can be found in section 9.

2. LITERATURE REVIEW

The following five components 2.1 to 2.5 are critical to understanding the investment policy of pension funds in the Netherlands. First of all, the background of the risk of DB (defined benefit) pension funds gives insight in the reasoning behind pension fund risk taking as a whole. Second, optimal asset allocation identifies two opposing views on optimal asset allocation by pension funds, explaining equity investments in DB funds. Third, measures of risk identify the dependent variables used in previous literature and the rationale behind them. Fourth, Dutch pension fund environment will give the necessary knowledge about the regulation and situation in the Netherlands regarding pension funds which is paramount for the selection of hypotheses to be tested. Fifth, previous studied factors give insight in the points of view for hypotheses of previous literature regarding risk-taking strategy.

2.1 Risk of Corporate Pension Funds

During the financial crisis of 2008, pension funds sustained significant losses on the market value of their assets. The funding ratio of the Dutch pension funds dropped drastically because of the crash in equity prices combined with the decline of long-term interest rate used to discount liabilities. Dreu and Bikker state that most pension funds are forced to increase premiums, cut wage and price indexation (Dreu and Bikker, 2009). There is a distinct difference in the risk allocation between defined benefit (DB) and defined contribution (DC) pension plans. With defined benefit plans, the benefits which are to be paid out when plan participants retired are set. The liabilities are thus fixed and the premiums are variable in order to accommodate for the set benefits. Defined contribution plans work the other way around. The contribution (premiums) of participants is set, while the benefits they get once they retire vary on the performance of the pension fund. There is a third type in the Netherlands, CDC, which stands for collective defined contribution pension plan. This is a hybrid from between DC and DB. The sponsor's liability is limited while participants' benefits are treated the same as in a DB scheme.

The risk for DB plans lies at the sponsor of the plan. If a funds' investments perform poorly, the sponsor may have to make additional contribution payments. But since higher returns results in lower future contributions, it is in the sponsors interest to take more risk (An, Huang & Zhang, 2013). In countries with a pension benefit insurance, PGBC, such as the U.S. this phenomenon is more common due to moral hazards such as risk shifting. Since a property of the DB pension plan is that each participant pays the same fraction of their salary to obtain fixed pension rights, younger generations are partly financing the pension rights of the older generations (Siegmann, 2007). Due to the fact that there is a group of participants who all are stakeholders, but differ in age they do not always share the same preferences as they may change over time (Bikker et al, 2009; Gerber & Weber, 2007; Alestalo & Puttonen, 2006).

An asset-liability mismatch, which endangers future pension benefits is typically a result from taking more investment risk with the expectation to achieve higher expected returns (Gorter and Bikker, 2011). The risk of a DB pension fund is that because of a too high variance in returns of high risk investments a temporary shortfall reduces the funding ratio and thus endangers the pension benefits.

The continuous ability to pay out the pension benefits should be the goal for DB pension funds thus ensuring a match between assets (risk) and liabilities (risk).

2.2 Optimal Asset Allocation

According to Bikker et al, there are two opposing views on optimal asset allocation by pension funds; the long-term strategy and the all-bonds strategy (Bikker et al, 2009). For the long-term strategy, the argument is that the risk of various asset categories are different for varying time horizons which results in portfolio choices by long-term investors will differ from short-term investors (Campbell and Viceira, 2002). This results in stocks being a favourable asset allocation for long-term investors due to their mean reversion (Hoevenaars, 2008). Equities may also partly hedge increasing wage- or inflation-indexed liabilities, due to the positive long-run correlation between the former and the latter (Lucas and Zeldes, 2006).

The all-bonds strategy states that the liabilities of a pension are bond-like (Bodie,1990). A risky asset mix has a long-term high expected return, but comes with a mismatch risk of assets and liabilities. The best strategy would thus be an all-bonds strategy with no mismatch risk. Thus, in the views there is a clear trade-off between providing security for the stakeholders while neglecting higher returns in the long run or focussing on the high returns while endangering the security of the stakeholders.

2.3 Measures of Risk

The main objective of pension fund investment policy should be the matching of assets and liabilities in order to provide a continuous stream of benefits to eligible participants. Most comparable identified research from Europe measure risk exclusively on the asset side when creating and testing models for risk policy.

Gorter and Bikker (2011) utilize the percentage of assets allocated in equity as well as Reid (2014) and Bikker et al (2009). However, the Pension Beta (Jin et al., 2006), has several advantages in terms of validity of the construct. Pension beta is the difference between pension asset beta, used in Mohan and Zhang (2013), and the pension liability beta, adjusted by the value of pension assets and liabilities as a percentage of the sponsors' total market value.

An, Huang and Zhang (2013) reason that Pension beta is a preferred measure of pension risk-taking because it incorporates the assets and liabilities into a consolidated framework. The consolidation is important because as previously mentioned the objective of a pension fund is to meet liabilities. Secondly, as a dynamic measure, pension beta reflects the mismatch between assets and liabilities over time. Equity percentage ignores the size and risk characteristics of pension liabilities. Thirdly, pension beta accounts for the magnitude of pension assets and liabilities relative to a sponsor's market value. This indicates the severeness of asset-liability misalignment for sponsors with large pension assets relative to their market capitalization (Metron, 2006). This is especially important for DB funds where the sponsor is liable in case of underfunding.

The pension beta used in An Huang and Zhang (2013) relates to risk exposure by incorporating this in the framework. A large pension beta (risk mismatch) means that given a change in underlying risk factors, plan assets and liabilities will change by different amounts. This will increase the gap between pension assets and liabilities. If a pension fund has a large risk mismatch (pension beta), they are more prone to market fluctuations.

To elaborate further on the pension beta and how this variable is influenced, a few extreme examples will be given. In these examples, it's assumed that other variables stay the same and the discussed variable is the only one that thus differs in the scenario.

If plan A has an all bonds strategy and plan B has a no bonds strategy, plan B will have a higher pension beta. This is due to the fact that plan B will have a higher pension asset beta, this will thus increase the amount by which plan assets are factored and increase the pension beta.

If plan A has a large asset pool as compared to their liabilities and plan B has a low asset pool as compared to their liabilities, Plan A will have a higher pension beta. This is due to the fact that plan A has a higher funding ratio and thus the asset side of the equation will be higher, while the liability side is lower. This will increase the pension beta. This can be counterintuitive, because at first sight a plan with more assets can be seen as less risky. However, because this plan has more assets it's more prone to market fluctuations (it will lose more money in a downturn) and thus has a higher risk mismatch.

If plan A is backed by a large sponsor and plan B is backed by a small sponsor, Plan B has a higher pension beta. This is because having a small sponsor will increases the risk of the disability of being backed during a downturn by a sponsor. If the plan has a large sponsor, the sponsor can help out the plan.

2.4 Dutch Pension Fund Environment

In order to understand which factors are relevant in the Netherlands, it is necessary to consider the current state in which pension funds in the Netherlands operate. The Dutch retirement system consists of the three-pillar system. The first pillar is the social security pillar which is based on a contributory-system. This means that there are specific taxes for the people who are working which are directly paid out to the elderly who have reached the legal retirement age. The benefit of this pillar is based on the amount of years a resident has lived in the Netherlands, so you don't have to work in order to receive this benefit once you reach the retirement age.

The second pillar is a plan which is linked to your work. A part of your salary is being invested by a pension fund and once you retire you get benefits based on the amount invested and the type of plan; DB, DC or CDC. The third pillar consists of what individuals save on their own initiative for their retirement.

The regulation in the Netherlands is funding orientated and the safety of the pension fund system is based on the solvency of the pension fund. The reason for this is that there is no pension insurance fund such as the PGBC in the U.S. (Franzen, 2010).

Franzen also notes that pension plan design in the Netherlands are still overwhelmingly DB, but most of them changed from the final salary plan to average salary plan. Average salary plans combine certain elements of DB and DC plans; thus, they may be better viewed as hybrid plans (Ponds, 2007). Another trend in the Netherlands is the change to CDC plans. "These hybrid plans offer DB guarantees to the employee, but qualify as a DC plan in accounting terms for the employer (sponsor)" (Franzen, 2010). The sponsor can no longer be made liable for shortfalls, but is not able to recover surpluses either. But one must say that social responsibility of the sponsor firm may dictate to back up the plan in difficult times even when it is a CDC plan. This CDC plan has at its core the intergenerational risk sharing between working people who still contribute and retirees. This means that because it's not an individual plan, downturns are buffered by the long-term nature of a pension plan and that participants of various ages are in it. In this way shortfalls are spread out over multiple years in the same way as good years.

The main risk management tool in the Netherlands is Asset-Liability-Management (ALM), which is legally required. Since the Netherlands also sues the fair value principle Kortleve and Ponds show that this distinction leads to a lower risk profile of the pension fund (Kortleve, 2006).

On the first of January 2015, a change of the regulation called nFtk passed. This changed certain aspects of what pension funds have to disclose such as their average funding ratio which is equal to the funding ratio of the average of the past 12 months. The reserves required such that the probability of becoming underfunded within one year is less than 97,5% stayed the same. Only after reaching this solvency, a pension fund can invest in risky assets. This means that the average pension fund must be funded at approximately 130 percent of their nominal liabilities in order to meet the 97,5% requirement (Franzen, 2010).

2.5 Factors of Risk and Hypothesis Development

The solvency of pension funds is a hypothesis which is extensively studied in most of the comparable previously discussed literature (An, Huang and Zhang, 2013; Bikker et al, 2009; Mohan and Zhang, 2013; Alestalo and Puttonen, 2005) They have found a positive relationship between funding ratio and risk taking, indicating that funds with higher buffers are willing to take additional risk. It is therefore hypothesized that for corporate plans, funding ratio is positively related to additional risk taking and therefor is positively related to risk mismatch (H1). All other factors staying the same, a pension fund with a higher solvency will take additional risk and thus have a higher pension beta.

The maturity of the pension fund stands for the distribution of the age of participants of the fund. Risk preferences changes over time, this is theorized in the lifecycle theory. As individuals age, their risk preference adapts because of their characteristics of labour income (human capital). A negative relationship has been found by various research (Bikker et al, 2009; Gerber and Weber, 2007; Alestalo and Puttonen, 2005; Reid, 2014). The assumption is that pension funds invest on behalf of their stakeholders and thus take the maturity into account. It is therefore hypothesized that for corporate plans, age has a negative relationship with risk mismatch (H2). All other factors staying the same, a pension fund with a higher participant average age will take less risk and thus have a smaller pension beta.

The size of the pension fund is in previous literature also related to the risk exposure of pension funds (Bikker et al, 2009; Gorter and Bikker, 2011; Reid, 2014). The reasoning is that larger pension funds have access to a higher degree of professionalism. A strong relationship between investor sophistication and size has been found by Dreu and Bikker (2012). Since large pension funds can capitalize on their economy of scale; hiring experts in investing in risky assets is attainable for them as the costs are marginal since the fund is so big. Thus, it is hypothesized that size is positively related to risk mismatch (H3). All other factors staying the same, a pension fund with a bigger size will take more risk because of professionalism and thus have a higher pension beta.

The relative wealth of a pension fund is a factor which is previously studied exclusively in Dutch literature (Bikker et al, 2009; Gorter and Bikker, 2011; Reid, 2014). Wealthier individuals seem to take more risk than their less fortunate peers. This effect is also studied for pension funds since these funds consist of many individuals. The hypothesis is that pension plans with more assets per plan participant is positively related to risk mismatch (H4). If wealthier pension funds take more risk, this translates to a higher pension beta.

The sponsor volatility of a pension fund indicates that pension funds adapt their risk strategy based on the ability of the sponsor firm to, if the returns of their pension fund is poor, make additional contributions. If a sponsor firm is unable to consistently back-up possible poor returns of their pension fund, the pension fund will take a less aggressive policy (An, Huang and Zhang; 2013). Thus, it is hypothesized that there is a negative relationship between the volatility of the operating cash flow of the sponsor and the risk mismatch (H5). Pension funds which are less confident on a back-up will take less risk which translates in a lower pension beta.

3. METHODOLOGY

In previous research about pension risk strategy in the Netherlands, the dependent variable has always only captured the asset side of risk. Either by looking at the (strategic) equity allocation (Bikker et al, 2009) or the (strategic) fund asset allocation (Reid, 2014). The step from equity allocation to asset allocation is one in the right direction since it is possible to measure alternative risk, which otherwise would have been neglected.

However, as reasoned before, pension funds balance their assets and liabilities. This means that possible misalignment between assets and liabilities is not measured if only equity or asset allocation is utilized. Therefore, in contrast to previous studies in the Netherlands, pension beta will be used as a measure for pension risk as done in research in the U.S. (An, Huang and Zhang, 2013).

Pension beta will be measured as in Jin et al. (2006). Pension Beta is estimated as pension asset beta minus pension liability beta, adjusted by the value of pension assets and pension liabilities as a percentage of a sponsor total market value.

$$\text{Pension Beta} = \beta_{Pa} \times \frac{FVPA}{D+E} - \beta_{pl} \times \frac{ABO}{D+E}$$

The asset beta is the weighted average beta of all asset classes in a pension fund. The beta per asset class is taken from Jin et al.

(2006, Table 4). The liability beta is based on the benchmark 30-year treasury bond rate. In this research the previously used value of 0,16 is used since both previous research Jin et al (2006) and An Huang and Zhang (2013) have determined this value for sponsor liabilities. The FVPA is the fair value of plan assets, since fair value is standard principle in the Netherlands I will take the value of the assets. ABO is the accumulated benefit obligation. These are the liabilities in our case. The D and E are the firm total debt value and equity value.

A large pension beta means that there is a risk mismatch. According to An, Huang and Zhang (2013), pension funds with a large risk mismatch are more prone to market fluctuation.

The funding ratio is disclosed by pension funds in the Netherlands as the “dekkingsgraad”. In this research the “average” funding ratio will be used for solvency, which is an average of the funding ratio of the previous 12 months.

For age the data is limited and thus average age, as used in Bikker et al. (2009), can’t be gathered. Therefore, the dependency ratio as used by Reid (2014) will be used, however it will be slightly changed. Instead of the ratio of active participants to retiree’s, the ratio of active participants to total participants – passive participants is used. The reasoning behind this is that if you have a fund with very few retiree’s the ratio used by Reid (2014) will be extremely high. If you take the ratio active participants to total participants the range will always be between 0 and 1. A high ratio means that the fund is young while a low ratio means that the fund is mature. The coefficient will be positive if the relationship between age and risk exposure is negative. Passive participants (sleepers) have also been included in this ratio, by factoring them with 0.1 and include them with the active participants. The scaling is thus total participants – 0.9 passive participants. Since the ratio active to total is used, we’ll call this ratio logically active participant ratio. Which thus is the inverse of the dependency ratio.

For size the number of plan participants is used. Bikker et al. (2009) and Reid (2014) differ in this measure since Reid argues that the total number of assets should be used since it’s the economy of scale which stands behind the reasoning. However, these two measures should have a high correlation. Total assets do not take into account future interest of young funds participants who haven’t been able to contribute much yet, but are likely to do so. Total number of assets could also create a build-in correlation with the dependent variable which incorporates total assets of the plan as well.

The relative wealth of the pension fund has total plan assets divided by the total number of participants. This is a measure for the generosity of the plan.

For sponsor volatility, the volatility of the sponsors 3-year EBIT is used as a measure. Since this research is interested in the volatility of the cash flow, the standard deviation of the 3-year EBIT is then scaled by the maximum absolute EBIT. Otherwise this measure wouldn’t reflect volatility as much as it would sponsor size.

The resulting model:

$$\begin{aligned} Pension\ Beta_i = {} & \alpha + \beta\ fratio_i \\ & + \gamma\ Active\ participant\ Ratio_i \\ & + \delta\ \ln(size)_i + \theta\ \ln(wealth)_i \\ & - \rho\ sponsor\ volatility_i + \varepsilon_i \end{aligned}$$

where i represents the pension fund and epsilon is the error term. Size and wealth are measured as the natural log as also done in Bikker et al. (2009) and Reid (2014) to reduce possible heteroscedasticity.

The model will be tested using multivariate regression.

4. DATA

The dataset used in this research was compiled from several sources. Firstly, a file with the most recent data (2015) about individual pension funds was retrieved from the DNB. Out of the 251 pension funds found in this list, 156 were determined to be corporate. These were selected by hand based on online DNB information. In order to find missing variables, the Reach Database was used. After excluding DC funds and funds with too much missing information this leaves a sample of 86 cases. Data was collected from annual reports, reach and DNB and manually double checked for variables available in 2 or 3 of these sources as well as randomly checked. Corporate pension funds in this sample are either of medium or large size, since small pension funds (less than 100 participants) aren’t disclosed in the DNB database which is the basis for this dataset. In 4 cases the sponsor volatility variable was constructed with the standard deviation of 2 years of EBIT instead of 3 years because this data was missing. In 5 cases the Asset Beta was constructed with the actual asset allocation instead of the strategic asset allocation, because this data was missing.

The dependent variable: Pension Beta, has been transformed using a natural log. The reason for the transformation of the dependent variable is that the original variable wasn’t normally distributed and residuals weren’t random.

In Table 1 you can see the descriptive statistics of the 86 corporate pension funds. When comparing this sample with data from other research there is one striking difference; the percentage of DB schemes. In Bikker et al (2009) 90% of all schemes in the sample was DB (data from end 2007) while in Reid (2014) 74,29% of all schemes in the sample was DB (data from 2011-2012). In the sample used in this research the percentage of DB schemes is 65,5%. The decline of DB funds by conglomerating to bigger DB funds and their conversion to CDC funds is thus can be seen clearly in the data. The funding ratios can’t be compared since in this research the

Table 1. Descriptive statistics of 86 pension plans

Variable (measurement)	Mean	Median	Minimum	Maximum	Std. Deviation
Pension Beta	0,56	0,17	0,00	9,24	1,38
Pension Beta (ln)	-1,59	-1,33	-8,14	2,70	1,95
Funding Ratio (ratio)	1,11	1,09	0,93	1,82	0,12
Size (ln)	8,55	8,50	5,60	11,52	1,29
Wealth (ln)	5,04	5,09	3,02	7,31	0,72
Sponsor Volatility	0,32	0,28	0,01	1,10	0,25
Age (Active Participant Ratio)	0,54	0,54	0,00	1,00	0,24

Table 2. Pearson correlation matrix

	Pension Beta (ln)	Funding Ratio	Size	Wealth	Sponsor Vol.	A P Ratio
Pension Beta (ln)		-0,205	-0,031	0,044	0,130	-,238*
Funding Ratio			,284**	-0,002	-0,184	0,097
Size (ln)				0,002	-0,168	-,219*
Wealth					0,164	-,312**
Sponsor Vol.						-0,144
A P Ratio						

Significances are marked with * denoting the 0.05 level (2-tailed) and ** denoting the 0.01 level(2-tailed)

Table 3. Pension Beta Regression

	Not transformed		ln	
	Coefficient	t-value	Coefficient	t-value
Funding Ratio	1,824	1,329	-2,76	-1,444
Size	0,088	0,692	-0,035	-0,196
Wealth	-0,202	-0,916	-0,106	-0,345
Sponsor volatility	0,891	1,411	0,548	0,622
Active Participant Ratio	-0,66	-0,958	-1,872*	-1,95
Constant	-1,127	-0,544	3,135	1,087
Adjusted R	0,008		0,04	
F	1,143		1,705	
Number of observations	86		86	

Sgnificance is marked with * which denotes the 10% level

"beleidsdekkingsgraad" is used instead of the normal "dekkingsgraad". To compare this reseearch with previous ones, descriptives have been transformed in the case of size and wealth with the natural log in order to be comparable.

Comparing the descriptive statistics to previous studies the active participation ratio is much lower than what Reid (2014) found, but Reid compared active participants to retirees. Reid found that for every 1 retiree, there were 2.2 active participants (mean) 1.46 active participants (median). In the sample of this research, there are almost as many active participants as retirees. This is even a bit higher than the measure of Reid because passive participants were factored in with the active participants, otherwise the mean and median would be a little bit lower. In Bikker et al (2009) 0,368 of participants is active, with 0,423 dormant. This would lead to approximately 0,4 using my variable construction. This is a bit lower than what I found for the mean, but still close. The descriptive statistics of the funding ratio are a lot higher in Bikker et al (2009) sample, with a mean of 1,39 while in this sample a mean of 1,11 has been identified. An explanation of this may be the fact that this research uses the average funding ratio instead of one point in time. For size this sample has a lower mean than bikker et al. (8,55 vs 12,9) which indicates that more, smaller sized pension funds are present in this sample. A lot more wealthier funds are in Bikker et al (2009) sample comparing their 13,6 with the 5,04 in our sample.

5. RESULTS

Table 2 presents the correlation results between the variables in the regression models. You can already see there is some strong indication of a relationship between the variables Pension Beta and the active participant ratio. Interestingly enough the signs of the relationships between the DV and IV's are the opposite of what was hypothesized. Only wealth shows the same sign as the hypothesis. Correlations between IV's may be an indication of multicollinearity and are thus also important. There is a strong indication between Size and the funding ratio as well as the Active participant ratio. For the active participant ratio, this is explained by the construction of the two variables. There also is an indication of a negative relationship between sponsor volatility and the funding ratio, which is also interesting.

Table 3 reports the results of the regression model. The coefficient of the active participant ratio is significant at the 10% level and is -1,872. This means that an increased active participant ratio results in a lower pension beta and thus risk mismatch. With all other variables staying the same, the difference between a fund with no active participants and one with only active participants would be that the fund with only active participants would have a -1,872 lower pension beta (ln).

For the non-transformed pension beta, no significant variables have been identified.

Table 4. Alternative dependent variables and omission of independent variables

	Weighted asset beta		Actual pension beta		Sponsor vol. Ommited		A P ratio ommited	
	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value
Funding Ratio	0,17**	2,00	-3,25*	-1,74	-2,91	-1,54	-3,362*	-1,752
Size	-0,01	-0,71	-0,07	-0,38	-0,05	-0,3	0,063	0,369
Wealth	-0,01	-0,6	-0,18	-0,60	-0,08	-0,27	0,076	0,254
Sponsor volatility	-0,02	-0,43	0,93	1,08	-	-	0,756	0,851
Active participant Ratio	-0,03	-0,66	-1,63*	-1,73	-1,95*	-2,05	-	-
Constant	-0,38***	2,93	12,71***	4,49	3,54	1,26	0,97	0,36
Adjusted R	0		0,06		0,047		0,01	
F	0,96		2,06*		2,05*		1,14	
Number of observations	86		86		86		86	

Significance is marked with * marking the 10% level, ** the 5% level and *** the 1% level.

6. ROBUSTNESS CHECK

To be able to check whether the hypothesis which were based on the concept that an increase in risk taking would increase the pension beta to be true at a lower level, the model is checked with the dependent variable weighted asset beta. The weighted asset beta is represented as βpa in the pension beta formula, which measures the investment risk. The second model will be checked on robustness for pension beta, but with the weighted asset beta build upon the actual asset allocation instead of the strategic one. Thirdly a model has been created with the sponsor volatility variable omitted to see how the other variables behave. The fourth model has the active participant ratio variable omitted in the model to check the same thing for another variable.

As you can see in the robustness check most of the independent variables in the weighted asset beta model aren't significant. However, funding ratio is positively related to the weighted asset beta and is significant at the 5% level. The sign is also what you would expect, a higher funding ratio means that a plan would take more risk. The other signs are too weak to take into account. The explanatory power of the model is also pretty weak. At a lower level the hypothesis for funding ratio thus seems to hold, but the explanatory power is rather weak.

For the Pension Beta constructed from solely the actual holdings, the results are the same as for the strategic model, but the explanatory power slightly stronger. The funding ratio is also significant at the 10% level as opposed to not being significant in the normal model which uses the strategic data. The signs for the significant variables are the same as in table 3.

For the model with the omission of variables the dependent variable pension beta (ln) is used. For the third model where sponsor volatility is omitted, there is no difference in how the model behaves. The signs are the same way, even when the only variable which influences the model positively is removed. This adds robustness to the findings in table 3.

For the model with the omission of active participant ratio, the explanatory power is much lower. The variables with the highest power still have the same signs, adding to the robustness of the original model.

Overall it can thus be said that the robustness of the findings has been indicated by the previous checks. On a lower level findings were as anticipated by the hypotheses and when omitting independent variables, the signs with the highest power stayed the same.

7. CONCLUSION

The goal of this paper was to discover which variables determine the mismatch risk of pension funds. The first hypothesis was that the funding ratio was positively related to mismatch risk, as well funded funds would invest in riskier assets as suggested by the literature which would in turn increase the mismatch risk because of an increased weighted asset beta. The results however, provide little evidence that the relationship is negative instead, based upon robustness checks. Well-funded pension funds seem to have less risk mismatch. Thus, the null hypothesis can't be rejected. The second hypothesis was that the age has a negative relationship with mismatch risk, based on the lifecycle theory that as people age they take less risk which translates to pension funds with a lot of retirees would take less risk and thus decrease the risk mismatch. Instead of a negative relationship, some evidence was found for a positive relationship between age and risk mismatch. Thus, the null hypothesis can't be rejected. For the other hypotheses; Size, wealth and sponsor volatility, no significant results have been found. It must be noted however, that the signs found for all variables for independent variables of pension beta and in the robustness check of actual pension beta were flipped which raises some questions which are discussed in the following section.

In order to check whether the data would give results similar to results found literature, a low-level model has been made to check the relationship between the independent variables and the weighted asset beta, which is a comparable, yet somewhat more sophisticated measure of equity allocation or equity percentage. In this model the only significant result was a positive relationship between funding level and the weighted asset beta. For the other variables, the significance is too low to take conclusions. For the other robustness models, the omitted variables made no difference in previous findings thus indicating robustness of the model.

8. LIMITATIONS AND DISCUSSION

The limitations of this research are that only a small sample has been used for analysis (86 funds). This may have influenced the results by not resulting in a correct sign or the production of a non-significant variable where in reality it would be significant.

Another limitation is that pension beta is a composite index with many factors influencing the variable. The independent variables are exclusively based on investment risk, thus neglecting other possible relationships which may have a better explanatory power. The pension liability used is derived from the literature on pension beta instead of calculated for the current period. Furthermore, as shown in the robustness test, only funding ratio produced a significant result for a low-level dependent variable, which decreases the model even more for the other independent variables. The striking finding that all variables have the wrong sign can be an indication of multi-collinearity, however this isn't indicated by a multi-collinearity test.

A possible explanation for the wrong sings can be that the reasoning behind all hypothesis, which was based on the investment risk influence on risk mismatch was too one angular to be correct. It can be reasoned for example that well-funded funds are a result of a variable which influences risk-mismatch as well; professionalism. A pension fund with many professionals would logically perform better, which would result in a higher funding ratio. But they would also be aware of their risks and may capitalize on this which would result in a lower risk mismatch.

Future research could be useful if a bigger dataset is being used. It would be very interesting to see if independent variable sings identified in such a research would be the same as in this research. Since this research was focussed on pension funds in the Netherlands, it would also be interesting to see how pension funds in other European countries manage their mismatch risk and what the results would be in such a research.

Another interesting aspect of future aspects may be taking into account the specific subclasses of the plans and see how this relates to the findings. A broader approach for the independent variables, in such a way that they are not just based on investment risk, may also be interesting.

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