Pension fund investment: Impact of the liability structure on equity allocation

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In this paper, the relationship between the liability structure and equity exposure of 41 Dutch corporate defined-benefit pension funds is studied. Theory observed a positive relationship of pension liabilities with equity returns over the long-term and suggests defined-benefit schemes are able to save future contribution costs when aligning their assets with their liabilities. This paper aims to observe this relationship in Dutch pension funds by incorporating the variables of wage inflation, workforce growth and return on liabilities as they were suggested in theory. However only a limited significant evidence of the growth in plan workforce and equity allocation was observed.

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1. INTRODUCTION

The most fundamental decision for pension funds is in what assets the funds of the participants should be invested. The return on the invested funds determines how much the retirees will get as their pension or how much the plan sponsor, mostly the company the employees worked for, will have to contribute to the plan. A sudden decrease in the pension assets would mean that either the employees would have to forgo a part of their pension or the employer would need to contribute additional assets. The decision of whether the sponsor or the employees have to make additional contributions to the pension plan depends mostly on the scheme, whether it is a defined benefit or defined contribution structure. In a defined benefit plan the pension benefit of the employees is determined in advance and the employer has to bear the risk of lower asset returns. Conversely in a defined contribution plan only the contribution of employees towards the plan is fixed and the benefit solely depends on the return of the assets without any risks for the employer. In this paper, the focus lies on the defined-benefit scheme which is still popular among many traditional employers in the Netherlands. The aim of this paper is to identify measurable variables that are relevant for the asset allocation of particularly defined-benefit schemes where the employer bears the risk for the pension. With the help of theory, the three variables the underlying wage inflation, workforce growth and the annual return on the pension plans liabilities are constructed. These variables are believed to be of high importance to assess how well a pension fund manages its assets in consideration of its future liabilities. Aligning assets with liabilities could save plan-sponsors money in the form of lower future contributions and also improve the overall safety of pensions for employees. The research in this paper is particularly based on the ideas of Black (1989) that there is a positive correlation of stock returns and pension liabilities. Furthermore, research by Peskin (1997) and Chun (2000) seems to confirm the positive relationship between equities and pension liabilities, and suggests that the liability structure should be measurable. Based on this insight, the question in this paper is asked whether this measurable relationship between the liability structure and equity exposure can also be observed in the Dutch pension system. For the measurement of the liability structure, the focus lies on the three variables of wage inflation, workforce growth and liability returns as they were proposed in the theory.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The important elements in the literature for this study are first the definition and measurement of the pension liability in general, then followed by the theories related to the relationship between the liability structure and equity exposure which is the core of this research.

2.1 Liability structure / Pension obligation

In order to manage the assets of the pension fund one needs to know what the liabilities are and how they can be measured. First, there are different definitions of the pension liability. A pension liability is generally described as having a certain structure, also called the liability structure. This structure tells how the liability looks like from the perspective of the fund which will pay-out the pension to the employees. Thus, a pension fund uses certain metrics to measure its liability structure. Common measures already used in theory include the age structure (Alestalo, 2005; Bikker, 2012), the size of the liability (Bikker, 2012) but also more economic measures such as wage inflation and workforce growth (Black, 1989; Lucas, 2009; Peskin, 1997). This paper focuses on the latter and will proceed in explaining the liability structure and previous theory more detailed.

Alestalo (2005) describes the liability structure as defining how much risk the fund can take in terms of its asset allocation since the development of assets and liabilities can be contradicting to each other. For this purpose, he divides risk into two categories: A risk of long-term shortfall and a risk of near-term shortfall. According to Alestalo (2005) there is a dilemma in choosing assets to reduce both near- and long-term risk because either the assets grow fast enough which reduces risk of falling below the liabilities in the long-term but increases the risk of underfunding in the near-term or the assets are stable enough to reduce near-term risk but grow to slow to not fall behind liabilities in the long-term.

The liability structure is directly related to the pension liability which is essentially the “present value of all benefits to be paid” as Black (1989, p.10) defines. Prior to Alestalo, Black also already distinguished between two views on the liability: A narrow view and a broad view. The narrow liability is the “present value of vested benefits for the current workforce” (Black, 1989, p. 10). It is the equivalent liability that would exist if all current employees would quit and not replaced. The narrow liability also takes into account the liabilities of the already retired workforce. To value this liability Black compares it to a security that pays dividends or interest. Each time benefits are paid the value of the liability decreases by the same amount like stocks do on ex-dividend dates. Funding or hedging the narrow liability is similar to the risk of near-term shortfall where an asset is needed that is relatively certain to produce a certain return for a specified time-frame rather than unpredictable returns in the long-term.

The other view on the liability that Black suggests is the broad liability. In contrast to the narrow liability, it is the “present value of all benefits to be paid by the plan.” It is always greater than the narrow liability and the equivalent to what a claim to all benefits would sell for on the open market. In addition to the narrow liability, it includes according to Black salary increases, all benefits to be accrued in the future, changes in benefits, retirements, deaths and additions to the workforce. Different to the narrow liability, it can only be based on expectations. To value the broad liability one needs to estimate for example the effects of salary inflation and additions to the workforce in the future. Black describes this as similar to the behavior of a security again, where the market also bases the price on the best estimate of future cash flows. According to Black, the broad liability can be treated as a security as long as the best estimate of future changes in benefits is used. The broad liability proposed by Black has a similar long-term perspective as Alestalo takes with the risk of long-term shortfall. Since both account for benefits that can occur infinitely in the future, an asset is needed with the same long-term return as the liability produces.

Peskin (1997) and Chun (2000) address two similar, although more abstract, views on the liability. Peskin distinguishes between liabilities that look like bonds and that look less like bonds. The comparison to bonds is meant to highlight the characteristics of the benefit payments in funds which are either relatively fixed and predictable like bonds or the opposite. For example, a liability of already retired employees is meant to look almost like bond payments. Chun addresses the same concept

used by Peskin and adds that when liabilities look less like bonds, they can be seen more like a continuous payment stream.

2.2 Liability structure and risk exposure relationship

The goal of this study is to investigate if the structure of the liability is reflected in the risk exposure of the asset portfolio. Specifically, the question is addressed if pension funds with growing liabilities that are due to workforce increases and wage inflation (e.g. in a growing firm) have a higher risk exposure than pension funds with a more stable and mature liability.

The link between the liability structure and asset allocation in a pension setting was addressed before by authors (Alestalo, 2005; Peskin, 1997; Bodie, 1990) with various approaches but rather similar objectives. The main argument is that pension funds always have to take into account their liabilities and cannot just focus on maximizing the return by applying traditional efficient frontier methods of asset allocation. Alestalo (2005) mainly argues that pension assets need to match pension liabilities both in terms of funding ratio and the correlation of the asset with the liability it funds. This argument mainly reflects the idea of the asset liability management (ALM) study which is often conducted in pension, banking, insurance and most other finance settings. The basic idea of ALM is to ensure that future cash flow needs are met accordingly by investing assets today. In the literature authors (Alestalo, 2005; Peskin, 1997; Bodie, 1990) are split between whether there should be a secondary goal of pension fund management which is according to Alestalo (2005) to achieve an "earnings spread". This spread reduces the need for future contributions by essentially increasing the return of the funds more than would be required to fund the current liabilities. This view essentially takes into account that in the future the liability will be much larger than today and thus it is the funds responsibility to invest accordingly already today and save the plan sponsors money in the form of reduced future contributions. This view explicitly favors the role of equity to achieve higher returns. Peskin (1997) comes to a similar conclusion in defined benefit funds and states that "better matching between assets and liabilities" can reduce risk and save the plan sponsor more than 20 percent of future contributions. On the other hand, Bodie (1990) argues that using higher risk and higher return assets in order to reduce future contributions has an adverse effect on shareholder wealth of the sponsoring company. Plan sponsors should aim for an "immunization strategy" for pension liabilities and reduce volatility to increase the value to the plan sponsor company's shareholders. This view favors inflation-hedged assets like inflation-protected bonds instead of equity.

2.2.1 Role of Equity

The role of equity as an asset in the relationship with the liability structure is a widely-researched subject. It is seen as a necessary component in most ALM studies that aim to achieve a full funding of all the liabilities as discussed in the previous section. The key concept to understand the role of equity in ALM is mentioned by Peskin (1997) who argues that if there would be an asset that would behave identically to the pension liability it funds, there would be no need for future contributions anymore. Peskin concludes after a set of simulations analyzing the relationship between equity exposure and plan-sponsor costs that the equity exposure of a pension fund is to a great deal influencing its future contribution costs. Since, a duration-match can be used to design an asset that behaves identically in a bond portfolio when the liability is fixed in terms of future benefit payments, most of the focus in the literature lies on accomplishing a similar method for liabilities that are more uncertain. Such liabilities were addressed in section 2.2 like the broad liability by Black (1989).

The broad liability is according to Black (1989) subject to a large set of developments like salary increases, retirements, deaths and additions to the workforce. Obviously, an asset that develops similar to such a liability is likely to be subject to the same developments. Black (1989) therefore focuses on the relationship between stock returns and salary increases. While Chun (2000) focuses on the same relationship, he also observes real estate and takes into account the reported pension liability instead of the salary increases itself. This difference should not result in a significant different result since pension liabilities are directly related to the wage level of employees.

Black (1989) argues that stock returns have tracked compensation growth over the long-term and thus stocks or equity should mostly be used to fund the broad liability. Arnott and Bernstein (1988) have observed a similar relationship and also found that neither interest income from cash nor Treasury bill returns could keep up with the inflation and productivity changes that drive compensation growth.

In conclusion, previous research has found evidence that equity returns track wage inflation over the long-term (Black, 1989; Arnott & Bernstein, 1988). This relationship is usually due to the general economic conditions which underlie equity and wage inflation. Thus, equities tend to surge when economic conditions are good and wages are increasing. Based on these arguments it is hypothesized

H1: *Equity exposure in a pension fund is, on average, positively related to the wage inflation of covered employees.*

Peskin (1997) also argues for the vital role of equity to fund the liability. However, he draws back on the importance of distinguishing between liabilities depending on how much they look like bonds. Therefore, he suggests to use equity for liabilities that look less like bonds. Such a liability shows a great deal of "noise" as measured by the volatility of the relationship between bonds and pension liabilities. Also, Peskin adds that the growth in workforce is an important determinant of equity exposure. A growing fund as measured by the growth in active liabilities, representing the share of active employees in the fund, should always have more equity exposure than a fund with more retired and not growing liabilities. With active liabilities Peskin (1997) refers to the share of participants as of the total participants which are active and thus currently accruing pension rights.

In conclusion, research has revealed that equities play a vital role in reducing plan costs when liabilities are subject to a growth in workforce (Peskin, 1997; Black, 1989). Thus, this papers second hypothesis reads as follows:

H2: *Pension funds with higher average annual workforce growth, measured as increases in active participants, report on average higher equity exposure.*

Similarly, Chun (2000) examines extensively the correlation between the development of equity, measured by the S&P 500 index, long term-government bonds, corporate bonds and real estate with the reported development of pension liabilities. Interestingly, the government and corporate bonds show the highest correlation with the liabilities, suggesting they would be

superior to invest in to reduce risk. The S&P 500 and real estate are still positively correlated with the return on pension liabilities. The fact that bonds seem to possess the highest correlation could be due to the short time-frame of the study which is only from 1989-1997. It can reasonably be argued that the long-term correlation with equities cannot be assessed in such a short time-frame because of the volatility of equities in each year. In this context, Chun also acknowledges that when liabilities are taken to be an ongoing payment stream that a bond portfolio can contain a great deal of risk. In such a situation he suggests that the lowest risk portfolio, as measured by the lowest future contribution costs, is constructed mainly by assets which relate mostly with the actual wage-inflation and not necessarily real inflation because pension liabilities are mainly determined by increases in wages and not the price of goods and services. Thus, he concludes by arguing that pension plans can reduce their costs in the long term by including equities and real estate because their high sensitivity to changes in wage levels and employment opportunities.

Because theory argues that equities are over the long-term correlated with the return on reported pension obligations (Chun, 2000), this papers third hypothesis reads as follows:

H3: *A pension fund on average reporting a higher return on its liabilities, measured as increases in pension liabilities per capita, is hypothesized to show a higher equity exposure than a pension fund reporting a lower return on its liabilities.*

3. METHODOLOGY

Similar to the other papers on pension fund asset allocation, this paper uses the actual asset allocation as its dependent variable. In order to make the measurement of asset allocation comparable to the theories discussed in in section 2, only the equity exposure is used to describe asset allocation. Black (1989), Peskin (1997) and Chun (2000) all focus mostly on the role of equity in funding the liability. In this context, it only makes sense to also consider only equity since its role in pension funds is already thoroughly studied. When taking into account the data on pension funds, the importance of equity over other risky asset classes is also confirmed since equity exposure is on average by far the largest and most consistent reported risky asset class. Data on private equity, hedge fund and other allocations towards alternative investments is considerably less consistent than equity with many pension funds only reporting it in the "other investments" category. The equity exposure is taken together with strategic equity exposure as reported at year-end on the last available annual report, either from 2014 or 2015.

Consequently, a set of measurements of the structure of the pension liability serves as the independent variable. Similar to other papers aiming to explain the equity exposure in pension funds (Alestalo, 2005: Rauh, 2009), a simple multivariate regression model is used in this paper to study the relationship. The regression model in this paper will test a linear relationship between the variables related to the hypothesis together with the control variables with the actual equity exposure of pension funds available in the sample. An unweighted and a weighted regression will be conducted separately in order to account for the different sizes of pension funds. The weighted regression attaches equal value to each participant, in contrast to the unweighted regression which attaches equal value to each fund. The weighted model is expected to better represent economic reality where the asset allocation of a large fund is more valid than of a small fund. Alestalo (2005), Rauh (2009) and Bikker et al. (2012) also used a linear relationship.

Table. 1 Description of variables

Variable	Description
X_A, X_S	X_A = Actual equity exposure; X_S = Strategic equity exposure
R_L	Average annual rate of return on liabilities. Computed as annual changes in per capita PBO between 2009-2015 (%).
Log (size)	Natural log of total assets (€ thousands).
Active share of participants	Share of plan participants who are active employees (%).
Funding ratio	Real funding ratio (%).
Indexation	Increase in accrued pension rights for active members between 2014-2015 (%).
R_W	Workforce growth as the annual rate of increase in active participants between 2014-2015 (%).

The model reads as follows:

$$X_{i(t)} = \alpha + \beta\, R_{L\,i(t)} + \gamma\, log\,(size)_{i(t)} + \delta\, active\ share\ of\ participants_{i(t)} + \theta\, funding\ ratio_{i(t)} + \varphi\, indexation_{\,i(t)} + \omega\, R_{w\,i(t)} + \varepsilon_i$$

To test the hypotheses discussed in section 2 of this paper, three variables are constructed. The first hypothesis states that wage inflation is related to the equity exposure of a fund. Since, the actual wage inflation cannot directly be observed for an individual pension fund, it is indirectly measured as the *indexation* offered by a fund to offset the impact of wage inflation Broeders (2014) finds that real wage growth is a key driver of indexation. However, he finds that the offered indexation is also the result of real inflation (CPI) and the funding ratio which makes it not only an indicator of wage inflation. A classification of the indexation data only to wage inflation is not available for this study. The indexation to wage inflation in a given year is expressed as a percentage and reflects the year-over-year increase in accrued pension rights for active members. This means the given percentage of indexation reflects the increase in pension payments to active members, thus employees that are still working at the sponsor company. In this model, the indexation percentages used for a fund represent the indexation offered for the fund's largest scheme in terms of member base. Indexation percentages are taken from the reporting years 2014 and 2015 with priority given to the last available data. Thus, a pension fund for which the indexation is only available for 2014 is treated the same as one which has a value for 2015 already available.

The second hypothesis states that *growth in the workforce* (R_W) covered by the pension plan is related to equity exposure. The growth in the workforce of an individual pension plan is measured in percentages as the year-over-year increase or decrease in its active participants as suggested by Peskin (1997). The active member base includes all members of the fund which in a given year accrue pension rights. Active members are generally current employees of the sponsor company and thus a good measure of workforce growth on the level of individual funds.

Table. 1 Descriptive statistics of 41 annual reports (2015)

Variable (measurement)	Mean	Median	Percentiles	
			10	90
Average annual rate of return on PBO per capita	10.27	10.23	7.60	14.28
Strategic equity exposure (% of total investments)	27.60	27.00	11.75	43.00
Actual equity exposure (% of total investments)	28.67	28.00	17.20	43.70
Total assets (in € thousands)	7516715	5028322	441587	23537207
Total number of participants	55955	65033	5709	96408
Share of active participants (in %)	28.88	24.21	19.06	44.27
Funding ratio (in %)	90.98	89.10	86.16	100.00
Indexation (in %)	1.10	0.79	0.00	2.51
Increase in active participants (in %)	-2.01	-2.53	-6.16	19.83

For the third hypothesis, the relationship between the growth in pension liabilities and equity exposure is measured. Identical to the research of Chun (2000) on pension liabilities, the average annual *rate of return on liabilities* (R_L) for a fund is used as a measurement. The annual rate is calculated by taking the averages of annual changes in per capita PBO. There are six years of data from 2009-2015 available. Chun (2000) worked with eight years of data from 1989-1997.

In order to compare the significance of the three variables proposed in this paper with other variables that were already observed to have a significant impact on equity exposure, three control variables will be included in the model. The first control variable *share of active participants* was a significant determinant of equity exposure in US pension funds as observed by Rauh (2009). There was a positive relationship between the share of active employees and proportional equity investment with a 1% larger share of active employees on average increasing the equity investment by 0.4%. A higher share of active participants indicates a younger fund since more participants are in working age and a lower share an older fund since more participants are either passive or already retired.

The other control variables relate to Bikker et al. (2012) who observed the impact of several demographic variables on equity allocation in Dutch pension funds. According to Bikker et al. (2012) *Size* and *funding ratio are* significant determinants of equity exposure. Bikker observed a positive relationship between the number of participants in a fund and its equity exposure. The same relationship is true for total assets as a measure of size according to Bikker. The data used in this paper has *total assets* and *total participants* available as a measure of *size*. The *funding ratio* used in this paper is the real funding ratio given by the De Nederlandsche Bank (DNB). It takes into account the expected rise in prices which means a ratio of 100% means a plan is able to meet its pension commitments as well as increase pensions with the promised indexation. Bikker found pension funds with higher funding ratios to invest more in equity. An average increase of the funding ratio by 1 percent translated into a 0.25 percentage increase in equity exposure. The variable *size* is like in Bikker's et. al. (2012) sample measured as its natural log to reduce heteroscedasticity. This is because there are more small funds than large funds which results in values for small funds to be more widely scattered.

4. DATA

The dataset used in this paper was initially retrieved from a list of Dutch pension funds published by the Dutch central bank (DNB). All non-corporate, defined-contribution (DC) and collective defined contribution (CDC) pension funds as well as funds no longer active were removed, resulting in a sample of 82 pension funds. Since the dataset collected from annual reports which was provided by the DNB did not include data on the PBO, this data was added to the dataset from the Reach database. The PBO is reported as technical reserves on the balance sheet of Dutch pension funds and was collected for each fund for the years 2009-2015. Total members were also collected for the same years to calculate per capita PBO. Only funds which reported a value for PBO and total members in every year were included in the analysis. A total of 41 funds satisfies this criterion. This leaves a dataset with the average pension fund showing an annual return on liabilities per capita of 10.27%. This rate is in the same range as the rate Chun (2000) found. Between 1989-1997 Chun found a mean rate of return on liabilities of 9.50%. However, he found the rate of return decreasing towards the end of the observed time-span with an average change of 7.50% after 1995.

When comparing the data on asset allocation in this sample with the work of others, the differences in equity allocations from country to country become obvious. Alestalo (2005) observed a lower average equity allocation in Finish pension funds of 20.2% when compared with the average allocation in this sample of 28.67%. Alestalo already reflected on the lower equity exposures in Finland and concluded that they are due to a regulatory limit imposed by the Finish government. Chun (2000) on the other hand found significantly higher equity allocations in the US, with the average fund investing between 45 to 60 percent of its total assets in equities. Most comparable to the findings in this sample are the findings of Bikker et. al (2012) who also researched Dutch pension funds and found an average allocation of 33.2 percent, slightly more than the findings in this paper.

Table. 2 Pearson correlation matrix

	X_A	R_L	Log size	Share active participants	Funding ratio	Indexation	R_W
X_A		0.16	-0.08	,374*	-0.04	0.03	,397*
		0.31	*0.60*	*0.02*	*0.81*	*0.86*	*0.01*
R_L			-0.23	,369*	-,336*	-0.05	-0.11
			0.16	*0.02*	*0.03*	*0.76*	*0.51*
Log size				-0.09	,315*	,399**	0.00
				0.59	*0.04*	*0.01*	*0.98*
Share active participants					-0.12	-0.25	,513**
					0.45	*0.12*	*0.00*
Funding ratio						0.15	0.19
						0.35	*0.24*
Indexation							0.07
							0.64
R_W							

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Other differences in the data that can be observed are the large differences in the sizes of the sample used by others. Alestalo (2005) used 44 pension funds, Bikker et al. (2012) 378 funds and Chun (2000) the most with 938 funds, compared to the 41 funds in this paper. Most of the differences can probably be attributed to the relative size of the respective samples to the total number of available pension funds in each country. However, compared to Bikker, this paper uses a smaller sample size of Dutch pension funds which is due to the low availability of data on pension liabilities (PBO) for multiple years. Also, the funds have on average more participants and more total asset, compared to the 42,300 participants and 1,791 million € in the sample of Bikker. This difference could be attributed to the fact that in this sample only corporate DB funds are included in difference to the DC, industry-wide and other funds which were included by Bikker et. al. (2012).

The other difference between this sample and the sample of Bikker is the difference in funding ratio which is 139.4% in Bikker's sample and only 90.98% in this sample. This is however due to the different calculation method of each ratio with Bikker's ratio being the nominal ratio that does not take into account the offered indexation of the plan.

5. RERSULTS

The results of the Pearson correlation between the different variables is represented in table 2. There is already some indication that there is a positive correlation (significant at the 5% level) between the variable of *actual equity exposure* (X_A) with the *share of active participants* and *workforce growth* (R_W). Other significant correlations are between the variable *size* and Indexation which are positively correlated (significant at the 1% level). Also, the *share of active participants* is positively correlated (significant at the 1% level) with *workforce growth* (R_W). These relationships are however not at the main interest of this paper.

Table 3 presents the results of the weighted and unweighted regression model estimating the actual equity exposure (X_A) of pension funds. The weighted regression model results in an increase in R-Square from 0.22 (unweighted) to 0.36 (weighted). The increase demonstrates that the variation in actual equity exposure is better explained by large funds with more participants than by small funds because of the higher weight attached to large funds. Also, the coefficient for the workforce growth (R_W) variable has become both significant (t-value 1.52 vs. 3.16)

Table 3. Actual equity exposure

	Unweighted		Weighted	
	Coefficient	t-value	Coefficient	t-value
R_L	0.22	0.55	0.74	1.52
Log size	-0.34	-0.41	-1.10	-1.12
Share active participants	0.10	0.85	-0.12	-0.96
Funding ratio	-0.04	-0.18	0.37	1.53
Indexation	0.83	0.50	0.40	0.29
R_W	0.16	1.52	0.29***	3.16
Constant	31.56	1.47	7.76	0.35
R-squared	0.221		0.359	
F	1.61		3.18	
Number of observations	41		41	

Significances are marked so that * denotes 10% level, ** 5% level, and *** 1% level.

Table 4. Strategic equity exposure as a robustness check

	Unweighted		Weighted	
	Coefficient	t-value	Coefficient	t-value
R_L	0.09	0.23	0.53	0.96
Log size	-0.74	-0.89	-1.77	-1.58
Share active participants	0.10	0.82	0.00	0.03
Funding ratio	-0.04	-0.19	0.58**	2.10
Indexation	-0.21	-0.13	0.43	0.28
R_W	0.19*	1.77	0.26**	2.54
Constant	39.89*	1.85	-3.88	-0.15
R-squared	0.26		0.37	
F	2.02		3.39	
Number of observations	41.00		41.00	

Significances are marked so that * denotes 10% level, ** 5% level, and *** 1% level.

and larger. In the weighted model this implies that a 1% higher workforce growth is correlated with 0.29% greater allocation to equity.

The other variables that aim to test the hypotheses in this paper, the return on liabilities (R_L) and indexation show no significant coefficients in the unweighted and weighted model. The observed results for the control variables mostly disagree with the results of the other authors since no evidence of an effect on equity exposure could be observed in this research. The first control variable the *share of active participants* was observed by Rauh (2009) to imply that firms with a 1% larger share of active participants to have a 0.4% higher allocation to equity. This effect could not be observed in this model with the variable having no significant effect. The effect of the second control variable size as measured by total assets which was observed by Bikker (2012) to have a positive effect on equity allocation could not be observed in this model. The third control variable, funding ratio which was observed before by both Bikker et. al. (2012) and Rauh (2009) to have a slight positive relationship with equity exposure also shows little evidence in this model.

6. ROBUSTNESS CHECK

In table 4, the variable strategic equity exposure (X_S) is used instead of the actual equity exposure as a robustness check. Since, strategic equity exposure is not subject to fluctuations in equity prices as it is the actual allocation, it can serve as an alternative measure of equity exposure of a pension fund. From the results, it becomes clear that workforce growth (R_W) appears to be the strongest determinant of strategic equity exposure. Similar to the model using actual equity exposure it has also a positive effect on strategic equity allocation. Workforce growth is more significant with strategic equity exposure. Similar to the model with actual equity exposure it also is more significant in the weighted than in the unweighted model, suggesting funds with more participants pay more attention to workforce growth. Funding ratio as a control variable is a more significant determinant of equity exposure for larger funds when the strategic allocation is used.

7. CONLUSION

The paper addresses the effects of wage inflation, workforce growth, and return on liabilities on the equity allocation of Dutch pension funds. Three hypotheses were asked in the beginning of the paper based on theory. The key findings from the analysis in the previous sections are grouped into three categories based on the differing hypotheses.

The first hypothesis on wage inflation could not be confirmed in the Dutch sample. The predicted positive impact of wage inflation is not significantly represented in a higher actual or strategic equity allocation. Even when indexation also takes into account the funding status of the plan and the general inflation, results may be interpreted as that the theory on the wage-equity relationship is little represented in the Dutch pension system. The arguments of Black (1989) and Arnott & Bernstein (1988) that pension funds could hedge against rising wages by investing more in equity was based on the theory that equity returns track wage inflation.

The second hypothesis on workforce growth can partly be confirmed in the sample. A significant positive relationship in weighted model and also a significant relationship in the unweighted model in the robustness check with strategic equity allocation implies that the effect is taken into account more by larger pension funds with more participants than by smaller pension funds and more in the strategic equity exposure than in the actual exposure. The reasons for this difference could be that larger funds tend to work more professional and have more resources to monitor the development of the workforce. Also, that the effect is more taken into account in strategic equity exposure could only be explained by equity price fluctuations affecting the actual allocation or operational issues resulting in a delay between strategic and actual allocation.

The third hypotheses on the return on pension liabilities could also not be confirmed in the sample. Funds with liabilities per capita on average increasing every year do not invest in more equity than funds with decreasing or stagnating liabilities. This observation is at odds with the theory by Chun (2000) that suggests, a growing pension plan with a high return on liabilities should need more equity allocation because of the high return on equities. Overall, results suggest that variation in the equity allocation is not well explained by the variables that the theory suggests should be important for equity allocation.

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