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Pension funds' allocations to hedge funds



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Abstract

In this paper, I investigate the investments in hedge funds made by the pension funds. I use an international sample of the largest pension funds during the period 2004-2017. I find that larger pension funds and those located in U.S. allocate more assets to hedge funds. Larger pension funds tend to invest less to funds-of-funds and pay more investments fees. I also find a negative relationship between the pension fund and its performance while manager tenure has a positive relationship with the hedge fund returns.

Keywords: Pension Funds, Hedge Funds, Investment Decisions

JEL Classification: G11, G23

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1. Introduction

This research investigates the largest pension funds and their investments in hedge funds. I analyze an international sample which entails pension funds located in U.S.A, Europe, New Zealand, Canada and Australia during the period 2004-2017. The research is mainly focused on public pension funds but some corporate ones are also included in the in the sample due to their significant amount of assets under management¹.

In order to construct my dataset, I manually collect the data from the annual reports of the pension funds and then I manually match them with the MorningStar database based on the name of the hedge funds. The initial international sample consists of the 264 largest pension funds worldwide from which the 168 are U.S. pension funds and the rest 96 are international. I drop the pension funds that do not invest in hedge funds and the ones that invest but do not report the names of the hedge funds that they invest in. The final dataset consists of 117 pension funds that they altogether invest in 1458 unique hedge funds.

The most important findings in the research are that larger pension funds and those located in U.S. allocate more assets to hedge funds, larger pension funds tend to invest less to funds-of-funds and pay more investments fees, the size of the pension fund has a negative relationship with its performance, and finally manager tenure has a positive relationship with the hedge fund returns.

This research contributes to the academic literature on asset allocation and pension fund performance, focusing on pension funds' asset allocation to hedge funds. It complements the existing yet limited literature for the pension funds' investment decisions regarding the hedge funds.

Pension funds as institutional investors play an important role to the economic stability. Over the last years they have experienced a steady and constant growth in their assets under management. According to the Willis Towers Watson *Pension and Investments* report, as for 2016 the total assets under management of the world's largest pension funds are US\$15.7 trillion with

¹ The RBS Group Pension Fund, Barclays Bank UK Retirement Fund, HSBC Bank UK Pension Scheme are some examples of corporate pension funds included in the initial sample.

the total pension assets to GDP ratio be 67% at the end of 2017. For the years 2011-2016, there is a cumulative growth of 23.4%. Defined benefit (DB) assets account for 65.5% of the disclosed total assets under management and increased by 5.6% in 2016. Defined contribution (DC) plans assets have increased their assets under management by 9.6% to 22.2%.

Along with the increasing assets, pension funds have to deal with the new demographic trends. The population is aging, people live longer and the fertility rates decline. In order to be able to confront these challenges they focus on their allocation strategies trying to find an optimal combination of investments so they can earn the necessary returns.

Therefore, over the last two decades, pension funds started to invest in alternative assets, such as private equity, real estate, infrastructure, commodities and hedge funds. The shift to alternative assets classes comes from their need to have a stable funding ratio and therefore constant high returns. The growth in the assets under management allocating to hedge funds is steady with the an approximate 8% allocation; the hedge fund industry has grown by 6.4% from 2015 to 2016 with assets under management reaching USD 3.2 trillion in 2016. (Fourteenth Annual Alternative Investment Survey, 2016). However, some pension funds still refrain or have stopped investing in hedge funds due to their lack of transparency and low past returns.

In order to diversify, achieve alpha and cover investors various needs, hedge funds adopt different investment styles. Investment strategies include: market neutral, long/short equity, macro driven, managed futures, distressed assets, relative value, arbitrage. In my dataset most pension funds allocate to strategies such as the global macro, absolute return, credit, diversified beta, equity market neutral and multi-strategy styles.

There are several benefits for investing in hedge funds. First, the investment strategies used by hedge funds can potentially generate positive returns in both rising and falling markets. Second, they have low correlations with traditional asset classes so they can offer diversification and uncorrelated returns. Third, there are numerous investment strategies that they employ; therefore they are able to meet the different pension funds' preferences. Fourth, hedge funds have the reputation to occupy talented investment managers ((Baker and Filbeck, (2017))).

At the same time, there are drawbacks in investing in hedge funds. Unlike other types of funds, hedge funds are not required to report information publicly, they are subject to less

regulation and are not transparent. Usually, they share their fund's report to a data vendor for marketing reasons, in order to attract new investors. In addition, they can require investors to lock up money for a period of years resulting in a lack of liquidity. They often use leverage, which exacerbates both potential gains and losses. Moreover, hedge funds charge high fees. So, a higher gross return is necessary to earn a higher net return ((Baker and Filbeck, (2017)).

Instead of investing directly to hedge funds, pension funds are able to invest to hedge funds through funds-of-funds. They provide a broader diversification and lower risk, since they do not follow a single investment strategy like some hedge funds do. Nevertheless, they charge double layers of fees which can significantly reduce the returns to investors. Moreover, just like hedge funds, funds-of-funds lack transparency and they have lock-up periods.

2. Theoretical Framework

In the first section, I present an overview of the existing literature regarding the hedge funds, pension funds and their asset allocation to hedge funds as well as to the whole alternative asset classes. In the second section, I mention the hypotheses that are analyzed.

2.1 Literature Review

There is an extended literature review regarding the asset allocation decisions of pension funds and their recent shift from the traditional asset classes to more risky alternative investments in order to obtain higher returns. The alternative asset classes contain investments in hedge funds, private equity, real estate, infrastructure and etc.

There is a debate whether alternative classes bring higher returns to pension funds. Hoevenaars, Molenaar, Schotman and Steenkamp (2007) argue that investing in the alternative asset classes will increase value for long-term investors. Lerner, Schoar and Wong (2007) attribute the superior performance to experience. They find that older institutional investors accomplish better performance than newer ones. In addition, they find that mostly endowment funds and to a lesser degree pension funds make better reinvestment decisions compared to the rest institutional investors. Dyck and Pomorski (2011) analyze defined benefit pension funds and find positive scale economics in asset management; more specifically, larger defined pension funds outperform the smaller ones by 43-50 basis points yearly. Furthermore, they argue that the cause for the superior returns of the larger pension funds comes from the increased allocation of funds to alternative investments which brings higher returns.

Jackwerth and Slavutskaya, (2016) find that institutional investors, inclusive of pension funds invest in hedge funds as a result of the diversification and the additional alpha they offer in order to enhance their portfolio performance. Moreover, they indicate that during the financial crisis, many pension funds increased their hedge fund holdings even though numerous of hedge funds failed at that period. Andonov, Bauer and Cremers (2017) argue that the U.S. public pension funds that have an increased percentage of retired members and state-political board members,

invest more in risky assets because they expect to earn higher returns, maintain higher liability discount rates, and have a lower performance. Dreu and Bikker (2009) state that a variety of pension funds allocate few or no assets to alternative assets which limits their diversification; in addition they state that their investment decisions are possibly based on less sophisticated approaches.

Pension funds invest in the hedge fund asset class directly or through funds-of-funds. Agarwal, Nanda and Ray (2013) document that larger investors tend to invest directly with hedge funds and less through funds of hedge funds which indicates that investors' size is a critical element of disintermediation.

There is a debate whether hedge funds are able to achieve higher returns in comparisons to other asset classes and explain the high fees they earn. Dichev and Yu (2011) report that there is not an outperformance regarding the hedge fund returns. The authors find that the returns of hedge funds do not depend exclusively on the returns of the funds they hold in their portfolio, but also on the timing and significance of capital flows. So, the result is that the investors of hedge funds earn an alpha that is almost zero and that as of 2008 their return is lightly higher than the return of the risk-free rate. Griffin and Xu (2009) question also the advanced skills and outperformance of hedge funds. They state that hedge funds show no competence to choose better stock styles or to time sectors and little evidence of differential ability among the different hedge funds.

On the other hand, Jackwerth and Slavutskaya (2016) indicate that adding a hedge fund portfolio to a pension funds increases the performance of the pension funds up to a certain point compared to the rest of the alternative assets. Edwards and Caglayan (2001) state that there are hedge funds that earn positive excess returns and those are the ones managed by skillful managers. Bouvatier and Rigot (2013) find that the pension funds investing in hedge funds gain higher global returns. These pension funds are large and sophisticated and they use a core-satellite organization. Camara Leal and De Melo Mendes (2010) state that by investing in hedge funds, pension funds improve the risk-return relationship, they gain higher annual accumulated return and decrease the portfolio rebalancing.

Investing in hedge funds requires both a management and a performance fee. Andonov, Bauer and Cremers (2012) find that larger pension funds have lower investment costs for two reasons. First, they negotiate and achieve lower management fees when they employ external

investment managers and second, because they are cost-effective when they invest internally. This does not lead though to better performance. Broeders, van Oord and Rijsbergen (2016) they do not find economies of scale in hedge fund investments and document that larger pension funds pay higher performance fees for hedge fund investments. Soydemir, Smolarski and Shin (2011) find that the funds that demand a high performance fee seem to outperform the funds that charge a relatively low fee and that the performance fees are positively associated with the possibility of providing a hurdle rate. The same relationship does not hold for the management fees.

Concerns have also risen about the transparency of the hedge funds. Cumming and Dai (2010) find that a number of hedge funds and especially those that do not have lockup provisions misreport the annual reports by smoothing the returns to seem that they constantly generate positive returns. In addition, Agarwal, Daniel and Naik (2007) claim that hedge funds inflate their returns for December because they want to be rewarded for their positive performance and avoid capital withdrawals from their investors.

Overall, pension funds invest in hedge funds and generally in the alternative asset classes because they aim to achieve diversification, reduce the portfolio risk and acquire higher portfolio returns but as stated by Stalebrink (2015) pension funds are constrained by information asymmetry and access to some types of alternative investments.

2.2. Hypotheses

In this section I present the four hypotheses that are tested in the empirical analysis.

Hypothesis 1: *Larger pension funds allocate more assets to hedge funds.*

There is a lot of research that is focused on the size of the pension funds and how it affects their decisions and performance. For example Dyck and Poromsky (2011) state that large pension funds allocate more assets to alternative investments which leads them to achieve higher returns. Therefore, for my first hypothesis I will test if there is a relationship between the size of the pension funds and their decision to invest in hedge funds.

Hypothesis 2: *Pension funds perform better when they invest in hedge funds.*

The second hypothesis will test whether pension funds achieve higher returns if they invest in hedge funds. As it is mentioned in the literature review Jackwerth and Slavutskaya (2016) indicate that adding a hedge fund portfolio to a pension funds increases the performance of the pension funds.

Hypothesis 3: *Manager Tenure has a negative relationship with hedge fund return.*

Fortin, Michelson and Jordan (1999) analyze the relationship between the performance of the mutual funds and the manager tenure. They document a negative relationship between manager tenure and turnover and a positive one between mutual fund size and manager tenure. Li, Zhang and Zhao (2010) find a strong positive correlation between fund age and manager tenure. With the third hypothesis, I want to test whether the negative relationship between performance and tenure is observed also in the hedge funds.

Hypothesis 4: *Pension fund return has a negative relationship with fees paid to hedge funds.*

Lastly, management and performance fees are an essential aspect of the hedge funds, hence with the fourth hypothesis I want to test whether fees have an impact on pension funds' performance and what is their magnitude.

3. Data and Methodology

3.1 Data Collection

In my research, in order to analyze the investments in hedge funds of the largest pension funds, I use yearly panel data for the period 2004-2017; In my dataset, 2004 is the year that most of the pension funds started to invest in the hedge fund asset class. Most of the pension funds are public, but few corporate ones are included. I obtain the data from two sources; the annual reports of the pension funds and the MorningStar database. To construct my dataset, I manually collect the data from the annual reports of the pension funds and then I manually match them with the MorningStar database based on the name of the hedge funds.

I use an initial international sample of the 264 largest pension funds worldwide from which the 168 are US pension funds and the rest 96 are international. I drop the pension funds that do not invest in hedge funds and the ones that invest but do not report the names of the hedge funds that they invest in. The final dataset consists of 117 pension funds that they altogether invest in 1458 unique hedge funds.

The data that are collected from the annual reports include yearly available information regarding the name of the hedge funds, the name of the firms, the investment style of the hedge funds, the assets allocated to hedge funds, the total allocation to hedge funds as percentage of the totals assets under management, the hedge funds' returns, the total pension funds' returns, the size of the pension funds and the fees paid to hedge funds. I merge the data from the annual reports with the MorningStar database. In total, 255 or 17.5% of the hedge funds are matched. The data that are collected from the MorningStar database incorporate information such as the fund size, the firm's total assets, the average manager tenure and whether the hedge fund is an offshore vehicle or not.

There are some limitations regarding the merging of the data with the MorningStar database. First, not all of the pension funds include the name of the hedge funds in their annual reports but some mention only the firm name; therefore the data cannot be merged since a firm has numerous of funds and hence it is hard to identify the specific funds that pension funds invest in.

Second, only the active hedge funds can be accessed in the MorningStar database; hence the inactive hedge funds are not merged.

Table 1

This table presents the number of hedge funds in the dataset and the total assets under management that the pension funds invested in them by year.

Year	No. of Hedge Funds	Total AUM (in \$million)
2003	1	
2004	25	1319
2005	75	5334
2006	104	6500
2007	156	11427
2008	251	17443
2009	425	20307
2010	460	26996
2011	562	32590
2012	734	34838
2013	849	40608
2014	1008	51972
2015	1054	56580
2016	1084	54333
2017	881	54669
Total Unique Funds	1458	

In Table 1, I present the total number of hedge funds that pension funds invest in from 2003 until 2017. For the year 2003 there is only one pension fund reported that invests in one hedge fund in the dataset. From the table it can be seen that there is a steady growth in the number of the hedge funds through the sample years and also a steady increase in the total assets under management allocated to hedge funds. Starting with 1 in 2003 and leading to 881 in 2017. The number of hedge funds in 2017 (881) is lower than in 2016 (1084) and this can be attributed to several reasons. Firstly, one explanation is that some of the annual reports for the year 2017 were not available during the time of data collection and therefore are not included in the dataset. Secondly, some pension funds report in their annual reports that they have stopped investing in hedge funds due to lower returns relative to their benchmarks such as the California Public Employees' Retirement System. Thirdly, another reason is that pension funds reduce the number of the hedge funds that they invest in, allocating more assets to specific ones. Fourthly, some pension funds stop reporting information about their investments in hedge funds in their annual reports.

3.2 Variables

In this section, I discuss the variables that I use for the analysis. In Table 2, I present all the variables that are used in the regressions and a brief description for each of them. Pension fund size, pension fund return, hedge fund return, fees, hedge fund allocation and hedge fund investments are variables that are constructed based on the annual reports of the pension funds. The variables for hedge fund manager tenure, offshore vehicle and fund-of-fund are obtained from the MorningStar database and the USA, Europe, Oceania and Canada dummy variables are constructed based on the location of the pension funds.

Table 2

This table shows the name of the variables that are used in the regressions and their description.

Variable	Description
<i>PF Size</i>	The total size of the Pension Funds
<i>PF Return</i>	The annual returns of Pension Funds
<i>HF Return</i>	The annual returns of Hedge Funds
<i>Fees</i>	The fees Pension Funds pay to Hedge Funds
<i>HF Allocation</i>	The asset allocation (%) to Hedge Funds
<i>HF Manager Tenure</i>	The average manager tenure in Hedge Funds
<i>Offshore Vehicle</i>	Whether the hedge fund is an offshore vehicle or not
<i>HF Investments</i>	The total investments in Hedge Funds
<i>USA</i>	Whether the Pension Fund is located in USA or not
<i>Europe</i>	Whether the Pension Fund is located in Europe or not
<i>Oceania</i>	Whether the Pension Fund is located in Oceania or not
<i>Canada</i>	Whether the Pension Fund is located in Canada or not
<i>FOF</i>	Whether it is a fund-of-fund or not

The pension fund size variable (*PF Size*) is constructed based on the yearly assets under management of the pension funds. Pension fund return variable (*PF Return*) is the annual time-weighted rate of return net of fees of the total portfolio of pension funds. Hedge fund return (*HF Return*) is the annual time-weighted rate of return of hedge funds. *Fees* variable contains both the management and performance fees and it refers to the fees that are paid to hedge fund managers relative to the asset allocation to hedge funds. Hedge fund allocation (*HF Allocation*) represents

the yearly percent allocation of asset to hedge funds. Hedge fund manager tenure (*HF Manager Tenure*) is the variable for the average amount of years that a manager has been at the helm of a hedge fund. *Offshore Vehicle* indicates whether a hedge fund is located in an offshore location, typically a tax heaven such as Bahamas or Cayman Islands. If it is, then the dummy variable has the value 1, otherwise the value 0. Hedge fund investments (HF Investments) is the yearly asset allocation to hedge funds in US dollars. *USA* is the second dummy variable that has the number 1 if the pension fund is located in USA and the value 0 otherwise. *Europe* is the third dummy variable that takes the number 1 if the pension fund is located in Europe and the value 0 otherwise. *Oceania* is the fourth dummy variable that takes the number 1 if the pension fund is located in Oceania (Australia and New Zealand) and the value 0 otherwise. *Canada* is the fifth dummy variable that takes the number 1 if the pension fund is located in Canada and the value 0 otherwise. Lastly, Funds-of Funds (*FOF*) is the sixth dummy variable that takes the number 1 if the pension fund is a fund-of-fun and the value 0 if not.

3.3 Descriptive Statistics

Table 3

This table presents the descriptive statistics of the pension fund size, hedge fund size, firm size, pension fund return, hedge fund return, fees, hedge fund allocation, hedge fund manager tenure, offshore vehicle, hedge fund investments and the month of that the pension funds report. For these variables, I resent the number of observations, the mean, the median, the standard deviation the range, the minimum and maximum value that a variable can take.

	Obs.	Mean	Median	Std. Dev	Range	Min	Max
PF Size	856	22.75	22.81	1.7	9.04	17.47	26.51
Hedge Fund Size	395	19.53	20.24	2.44	19.95	4.38	24.34
Firm Size	452	21.57	21.74	2.69	22.03	4.39	26.42
PF Return	836	7.31	8.5	8.94	66.4	-30.4	36
HF Return	604	4.58	5.3	7.69	80.2	-31.2	49
Fees	187	0.25	0.012	0.73	6.33	0	6.33
HF Allocation	786	0.07	0.05	0.05	0.32	0	0.32
HF Manager Tenure	349	13.79	12.83	5.9	29.11	3.25	32.36
Offshore Vehicle	896	0.19	0	0.4	1	0	1
HF Investments	493	17.18	17.84	2.35	17.81	4.28	22.09
Month	415	6.35	6	1.52	9	3	12

Table 3 contains the descriptive statistics of the pension fund and hedge fund characteristics. The median size of the pension fund is 22.81 billion us dollars whereas the median size of the hedge fund is 1.9 billion dollars. The median annual time-weighted rate of return of pension funds is 8.5% while the median rate of return of hedge funds is 5.3%.

Table 4

This table presents descriptive statistics of pension funds regarding their size, annual returns, hedge fund returns and hedge fund allocation for the whole sample period (2004-2017) and for sub-periods before, during and after the global financial crisis

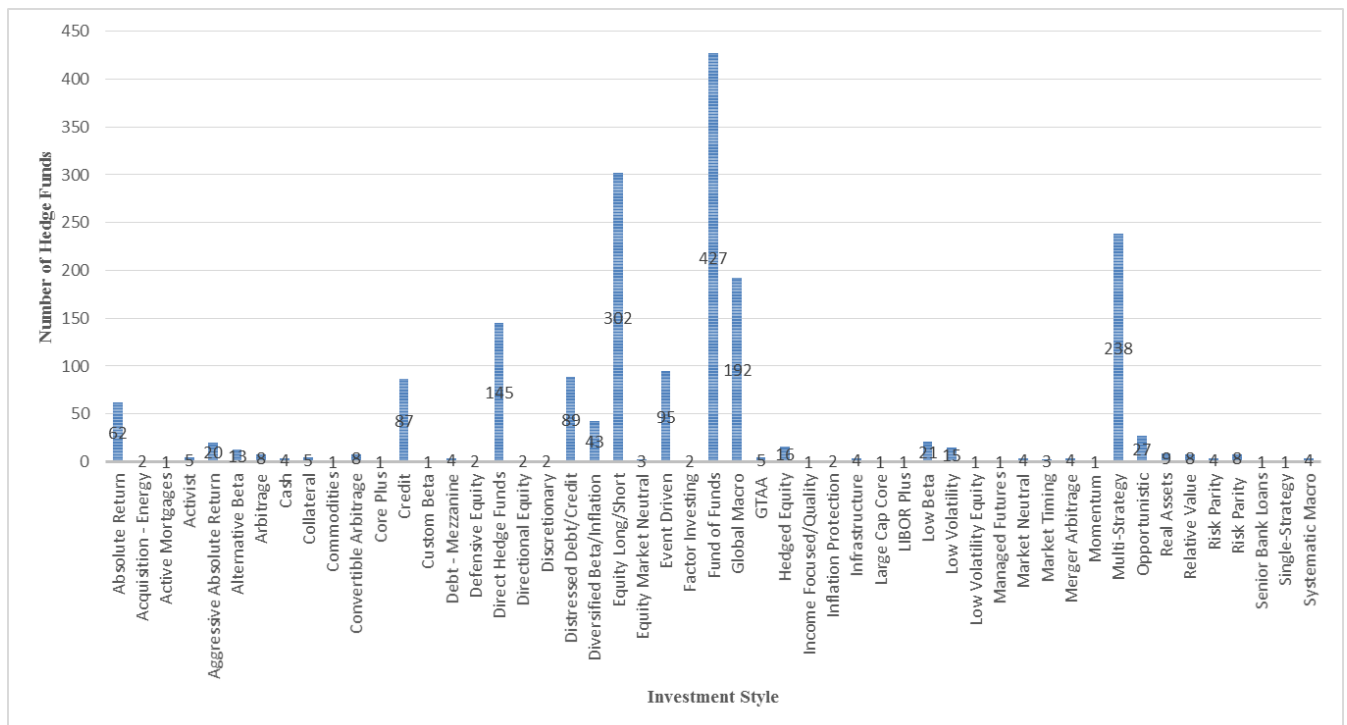
	Obs.	Mean	Std. Dev.	Min	Max
2004-2017					
<i>PF size</i>	856	22.75	1.7	17.5	26.5
<i>Total Return</i>	836	7.3	9.9	-30.4	36
<i>HF Return</i>	604	4.58	7.69	-31.2	49
<i>% to HF</i>	786	0.069	0.05	0	0.32
2004-2006					
<i>PF size</i>	33	8.18	1.63	4.75	11.53
<i>Total Return</i>	32	11.3	2.27	6.3	15.49
<i>HF Return</i>	17	10.61	10.47	1.8	49
<i>% to HF</i>	30	0.057	0.052	0.01	0.24
2007-2008					
<i>PF size</i>	70	8.64	1.72	4.67	11.96
<i>Total Return</i>	69	1.7	14.9	-30.4	28.85
<i>HF Return</i>	44	4.5	9.16	-15.9	22.71
<i>% to HF</i>	61	0.055	0.043	0	0.25
2009-2017					
<i>PF size</i>	753	8.99	1.69	3.654	12.69
<i>Total Return</i>	735	7.69	9.34	-26.54	36
<i>HF Return</i>	543	4.39	7.39	-31.2	36.4
<i>% to HF</i>	695	0.071	0.05	0	0.32

From the range column it seems that both pension fund and hedge fund returns have volatile values throughout the sample period. Moreover, pension funds allocate a median of 5% of their assets to hedge funds while the median manager stays at the hedge fund for 13 years. In total, 19% of the hedge funds that were merged are offshore vehicles located in Cayman islands and Bermuda and most of the pension funds report in June.

Table 4 contains descriptive statistics for the whole sample period 2004-2017 and for the years before, during and after the financial crisis. Most of the observations are concentrated during the years 2009-2017. The main observation is that there is a higher allocation to hedge funds during the years after the financial crisis. This can be attributed to the fact that pension funds need a stable funding ratio with constant high returns; therefore they allocate more assets to hedge funds aiming to diversify and gain uncorrelated returns. In addition, the average total return for the pension funds and the average total return of the hedge funds seem to be higher the years before crisis but conclusions cannot be made since the observations are the fewest for this period.

Graph 1:

The graph shows the investment styles employed by the hedge funds in the sample.



There is a variety of investment styles that are implemented by hedge funds in order to diversify. Pension funds seek a balance of investment styles based on their risk tolerance and risk characteristics Gregoriou (2006). Graph 1 shows the different investment styles that hedge funds follow in the dataset. Most pension funds allocate to hedge funds that offer global macro, absolute return, credit, diversified beta, equity market neutral and multi-strategy styles.

Table 5

Pearson correlation coefficient for the manager tenure, hedge fund allocation, pension fund size, pension fund return, hedge fund return and fees.

	Manager Tenure	HF Allocation	PF Size	PF Return	HF Return	Fees
Manager Tenure	1					
HF Allocation	-0.0627	1				
PF Size	0.0145	0.0631*	1			
PF Return	-0.1144*	-0.0465*	-0.1142*	1		
HF Return	0.0961	0.1906*	-0.1643*	0.4682*	1	
Fees	0.0167	0.4859*	0.5712*	-0.0524*	0.1919*	1

Table 5 illustrates the correlations among variables manager tenure, hedge fund allocation, pension fund size, pension fund return, hedge fund return and fees. There is a small statistically significant positive correlation between the pension fund size and the hedge fund allocation which means that the variables may have a non-linear relationship. There is a statistically significant negative correlation between pension fund size and pension fund return but also between pension fund size and hedge fund return. In addition, there is a strong positive relationship between the pension fund return and the hedge fund return as with the hedge fund allocation and the fees.

3.4 Methodology

For this research I use multivariate panel data regressions since the dataset is consisted of time-series data with a panel-structure. The panel is unbalanced since it contains observations of different pension funds over different years.

In the regression I use year fixed effects (λ) and cluster the standard errors by pension fund due to the fact that multiple pension funds can invest in the same hedge fund. I check for autocorrelation but I find no evidence for that. The regressions take the following form:

$$Y_{i,t} = \alpha + \beta x_{i,t} + \lambda t + v_{i,t} \quad (1)$$

Where:

Y = independent variable

x = dependent variable

α = the intercept term

β = slope coefficient

$v_{i,t}$ = error term

$t=1,\dots,T$

$i=1,\dots,N$

λ = year fixed effects

In my first regression, the independent variable is the hedge fund allocation and the dependent variables are the pension fund size, hedge fund return, pension fund return, and the dummy variables funds-of-funds, USA, Europe, Oceania and Canada. This regression is constructed in order to test the first hypothesis:

Larger pension allocate more assets to hedge funds.

$$HF Allocation_{i,t} = \alpha + \beta_1 * PF Size_{i,t} + \beta_2 * HF Return_{i,t} + \beta_3 * PF Return_{i,t} + \beta_4 * FOF_{i,t} + \beta_5 * USA_{i,t} + \beta_6 * Europe_{i,t} + \beta_7 * Oceania_{i,t} + \beta_8 * Canada_{i,t} + \lambda t + v_{i,t} \quad (2)$$

For the second regression the independent variable is the pension fund return and the dependent ones are the hedge fund return, hedge fund allocation, fees, pension fund size and the

dummy variables that indicate whether the pension fund is located in USA, Europe, Oceania or Canada.

$$PF\ Return_{i,t} = \alpha + \beta_1 * HF\ Return_{i,t} + \beta_2 * HF\ Allocation_{i,t} + \beta_3 * Fees_{i,t} + \beta_4 * PF\ Size_{i,t} + \beta_5 * USA_{i,t} + \beta_6 * Europe_{i,t} + \beta_7 * Oceania_{i,t} + \beta_8 * Canada_{i,t} + \lambda t + v_{i,t} \quad (3)$$

The second hypothesis is tested: *Pension funds perform better when they invest in hedge funds.*

In order to check the third hypothesis *Manager Tenure has a negative relationship with hedge fund return*, I use the third regression where the hedge fund return is the independent variable whereas fees, offshore vehicle, manager tenure, pension fund size, USA, Europe, Oceania and Canada constitute the dependent variables.

$$HF\ Return_{i,t} = \alpha + \beta_1 * Fees_{i,t} + \beta_2 * Offshore\ Vehicle_{i,t} + \beta_3 * Manager\ Tenure_{i,t} + \beta_4 * PF\ Size_{i,t} + \beta_5 * USA_{i,t} + \beta_6 * Europe_{i,t} + \beta_7 * Oceania_{i,t} + \beta_8 * Canada_{i,t} + \lambda t + v_{i,t} \quad (4)$$

In the fourth and last regression, I use fees as the independent variable and pension fund size, funds-of-funds dummy, hedge fund allocation, pension fund return, USA, Europe, Oceania and Canada as the explanatory variables. The fourth hypothesis is tested: *Pension fund return has a negative relationship with fees paid to hedge funds.*

$$Fees_{i,t} = \alpha + \beta_1 * PF\ Size_{i,t} + \beta_2 * HF\ Return_{i,t} + \beta_3 * FOF_{i,t} + \beta_4 * HF\ Allocation_{i,t} + \beta_5 * PF\ Return_{i,t} + \beta_6 * USA_{i,t} + \beta_7 * Europe_{i,t} + \beta_8 * Oceania_{i,t} + \beta_9 * Canada_{i,t} + \lambda t + v_{i,t} \quad (5)$$

4. Empirical Results

In this section, I present the empirical results of the analysis that I perform to test my hypotheses. First, I include three graphs that show the evolution of the hedge fund allocation, hedge fund return and pension fund return over the sample period, 2004-2017, and a scatter plot of hedge fund return and pension fund return.

Graph 2: : Hedge fund allocation per year



Graph 2 shows that the average allocation to hedge funds is decreased during the beginning of the financial crisis in 2008 but it is increased again from 2009. As it is depicted in Table 4, there is an increase in the pension fund size which indicates that there more pension funds in the sample for the subperiod 2007-2008 comparing to the 2004-2006 subperiod; hence the decrease in the asset allocation can be attributed to the lower asset allocation to hedge funds from the new pension funds. Graph 3 indicates that there is a decline in the average return of hedge funds from 2006 until it reaches its lowest point during the crisis. There has been an increase since then. These observations are supported also by Jackwerth and Slavutskaya (2016) who find that pension funds

increased the holdings in hedge funds during the financial crisis because they wanted to boost the portfolio performance, even though a large number of them failed that period.

Graph 3: Hedge fund returns per year



Graph 4: Pension fund returns per year



In graph 4, it is evident that there has been a fluctuation in the annual returns of pension funds throughout the sample period. As it is observed there is a major decline in performance during the years 2008 and 2009 where most of the pension funds report negative rate of returns.

Graph 5 is a scatter plot of hedge funds returns and pension funds returns. It demonstrates a positive relationship between the two variables which is intuitively correct; the positive return of the pension fund is determined by the returns of the asset classes it invests in.

Graph 5: Hedge fund return and pension fund return



Table 6 contains regression with the hedge fund allocation being the independent variable. All regressions show a significant association of pension fund size with the hedge fund allocation. The effects of a 10 percent increase in pension fund size are respectively 0.187% and 0.175%. The effect is similar when I cluster by pension fund and include time fixed effects. This comes in line with the first hypothesis that *Larger pension funds allocate more assets to hedge funds*. I find no significant relationship between hedge fund return and hedge fund allocation when I include fixed effects and clusters. The same is observed for the pension fund return.

In the second regression, I find a negative relationship between hedge fund allocation and funds-of-funds when I control for size. Larger investors allocate less to funds-of-funds. This can be explained by the finding of Agarwal, Nanda and Ray (2013) who found that larger investors invest more directly than using funds of hedge funds (FOFs).

Table 6

This table presents regressions in which the independent variable is hedge fund allocation. The dependent variables are the pension fund size, hedge fund return, pension fund return, funds-of funds dummy and the dummy variables for the USA, Europe, Oceania and Canada. I include time fixed effects and cluster the standard errors by pension fund in the third and fourth regression. I report standard errors in brackets. *, **, and *** indicate significance levels of 0.10, 0.05, and 0.01, respectively.

	(1) HF Allocation	(2) HF Allocation	(3) HF Allocation	(4) HF Allocation
PF Size	0.0187*** (15.32)	0.0175*** (19.13)	0.0183*** (3.02)	
HF Return	0.00231*** (5.71)		0.00245 (1.54)	
PF Return	-0.00185*** (-5.46)		-0.00196 (-1.64)	
FOF	-0.00835* (-1.94)	-0.0167*** (-5.88)	-0.00833 (-1.01)	
USA	0.0836*** (11.97)		0.0820*** (5.41)	0.0544*** (5.26)
Europe	0.0291** (2.21)		0.0211 (0.90)	0.0219** (2.01)
Oceania				0.0356*** (3.65)
_cons	-0.407*** (-13.47)	-0.319*** (-15.33)	-0.395** (-2.65)	0.0180*** (3.09)
Time Fixed Effects	No	Yes	Yes	Yes
Cluster by PF	No	Yes	Yes	Yes
Observations	799	1556	799	6336
Adj. R-Squared	0.3575	0.2029	0.3580	0.064

There are not large differences in percentage allocated to hedge funds between USA, Europe and Oceania. A 10% increase leads to a 0.5%, 0.2% and 0.356% increase in hedge fund allocation respectively. From all the regions though, American pension funds allocate more assets to hedge funds.

For all the models, the adjusted R-squared indicates the explanatory power and it remains almost the same when time fixed effects and clustering are implemented; they have similar explanatory power regarding the hedge fund allocation.

Table 7 shows the regressions for the pension fund return. All regressions show a significant positive relationship between hedge fund return and pension fund return. This strong connection was also indicated by the scatterplot (Graph 5). A 10% increase in the hedge fund return, leads to an 8.62% and 9.07% increase in the pension fund return.

I spot a negative relationship between hedge fund allocation and pension fund return but this relationship does not hold when I use clusters. Therefore, I cannot come to a solid conclusion for the second hypothesis which states that *Pension funds perform better when they invest in hedge funds*. The same is observed between management fees and pension fund return.

Pension fund size has a negative and significant coefficient at 5% with the pension fund return. A 1% increase in the pension fund size induces a 1% decrease in pension fund return indicating that larger pension funds underperform relative to the smaller ones.

I find significant negative coefficients on the dummies for the pension funds located in USA, Oceania and Canada. A 1% increase of the USA dummy causes a -5% decrease in pension fund return, a 1% increase of the Oceania dummy -8.8% and a 1% increase of the Canada dummy -5.6%. Pension funds based in Oceania have lower returns during the sample period relatively to the American and Canadian pension funds. From the first regression, European pension funds seem to perform better but no clusters are included.

In addition, such as in the previous regressions, the adjusted R-squared remains almost the same when clustering is implemented.

Table 7

This table presents regressions in which the independent variable is the annual time-weighted rate of return net of fees of the total portfolio of pension funds. The dependent variables are the annual rate of return of hedge funds, hedge fund allocation, fees, pension fund size and the dummy variables for the USA, Europe, Oceania and Canada. I include time fixed effects and cluster the standard errors by pension fund in the third and fourth regression. I report standard errors in brackets. *, **, and *** indicate significance levels of 0.10, 0.05, and 0.01, respectively.

	(1) PF Return	(2) PF Return	(3) PF Return	(4) PF Return
HF Return	0.862*** (54.51)	0.914*** (51.77)	0.862*** (14.03)	0.907*** (10.22)
HF Allocation	0.738 (0.40)	-12.41*** (-4.29)	0.738 (0.06)	-12.58 (-1.04)
Fees	-0.0264 (-0.32)	-0.260** (-2.15)	-0.0264 (-0.06)	-0.238 (-0.53)
PF Size	-0.161 (-1.71)	-0.974*** (-11.50)	-0.161 (-0.46)	-1.007** (-2.66)
USA	0.527 (0.15)		-5.083*** (-4.10)	
Europe	5.610*** (4.85)			
Oceania	-3.190*** (-3.35)		-8.800*** (-5.96)	
Canada			-5.610** (-2.40)	
_cons	7.362*** (3.62)	31.50*** (24.62)	12.97* (1.82)	31.98*** (4.08)
Time Fixed Effects	Yes	Yes	Yes	Yes
Cluster By PF	No	No	Yes	Yes
Observations	2062	2074	2062	2064
Adj. R-Squared	0.7942	0.7488	0.7942	0.7489

Table 8 displays the regressions for the hedge fund return. There is a positive relationship between hedge fund return and management fees paid to hedge funds. A 1% increase in the fees causes 2.6% to 3.08% increase in hedge fund return. This finding is intuitively correct since the higher returns a hedge fund achieves, the higher performance fees demands from the pension funds.

In the second regression, I find a negative and significant coefficient at 10% between the hedge fund return and the offshore vehicle status. If a hedge fund is an offshore vehicle then a 1% increase leads to a 1.959% decrease in its return; offshore hedge funds underperform relative to the rest. Moreover, manager tenure has a positive relationship with the hedge fund returns. A 10% increase of the manager tenure has as a result a 1.36% increase in hedge fund return which contradicts with the third hypothesis that *Manager Tenure has a negative relationship with hedge fund return*. The higher hedge fund returns could be attributed to the experience of the managers; the more the years a manager is a portfolio manager of the current hedge fund the higher the returns of the fund.

Pension fund size has a negative coefficient with the hedge fund return. A 1% increase in the pension fund size causes a 1.87% and 2.62% decrease in the hedge fund return. Larger pension funds earn lower returns from their hedge fund investments. For the regional dummies, I find positive and significant coefficients for the pension funds that are located in USA and Europe and a negative coefficient for the pension funds in Oceania. European pension funds seem to make the best hedge fund allocation decisions since they have the highest returns from hedge fund investments followed by the American pension funds.

Finally, Table 9 contains the results for the regression on management fees paid to hedge fund managers. I find a positive relationship between pension fund size and fees. A 1% increase in pension fund size leads to 0.92% increase in fees. Larger pension funds pay more fees; this can be explained by the previous finding that larger pension funds tend to invest more in hedge funds which causes them to pay more fees eventually. Nevertheless, the variable Fees contains both the management fee and the performance fee. Andonov, Bauer and Cremers (2012) find that larger pension funds negotiate and achieve lower management fees when they employ external investment managers. So, the positive coefficient can also be driven mainly by the performance fees.

Table 8

This table presents regressions in which the independent variable is the annual rate of return of hedge funds. The dependent variables are the fees, offshore vehicle dummy, manager tenure, pension fund size and the dummy variables for the USA, Europe, Oceania and Canada. I include time fixed effects and cluster the standard errors by pension fund in the third and fourth regression. I report standard errors in brackets. *, **, and *** indicate significance levels of 0.10, 0.05, and 0.01, respectively.

	(1) HF Return	(2) HF Return	(3) HF Return	(4) HF Return
Fees	2.969*** (8.44)		3.080*** (6.51)	2.624*** (6.30)
Offshore Vehicle	0.0688 (0.06)	-1.959* (-1.91)	0.541 (0.83)	
Manager Tenure	-0.00819 (-0.09)	0.136* (1.71)	-0.0300 (-0.61)	
PF Size	-1.914*** (-4.21)	-0.603 (-26.89)	-1.877*** (-6.73)	-2.624*** (-3.78)
USA	10.74*** (2.63)	-1.608 (1.71)	12.29*** (9.25)	-2.926 (-1.21)
Europe	18.13*** (4.05)		20.34*** (7.99)	
Oceania		1.167 (0.86)		-4.066* (-1.89)
Canada				-5.328 (-1.43)
_cons	-7.982 (-0.67)	19.06 (8.53)	-12.14 (-0.90)	29.38* (1.98)
Time Fixed Effects	No	Yes	Yes	Yes
Cluster By PF	No	Yes	Yes	Yes
Observations	83	154	83	2063
Adj. R-Squared	0.6181	0.0868	0.6198	0.4563

Table 9

This table presents regressions in which the independent variable is the fees. The dependent variables are the pension fund size, the hedge fund return, fund-of-funds dummy, hedge fund allocation, pension fund return and the dummy variables for the USA, Europe, Oceania and Canada. I include time fixed effects and cluster the standard errors by pension fund in the third and fourth regression. I report standard errors in brackets. *, **, and *** indicate significance levels of 0.10, 0.05, and 0.01, respectively.

	(1) Fees	(2) Fees	(3) Fees	(4) Fees
PF Size	0.975*** (58.75)		0.971*** (35.10)	
HF Return	0.0000594 (0.01)		0.00116 (0.08)	
FOF	-0.0534 (-0.85)		-0.0656 (-1.14)	
HF Allocation	8.075*** (16.06)		7.895*** (8.51)	
PF Return	-0.0177*** (-2.46)		-0.0186 (-0.91)	
USA	0.665*** (4.59)	-2.970*** (-7.93)	0.640** (-2.27)	-2.961*** (-7.59)
Europe		-5.333*** (-14.13)		-5.329*** (-42.43)
Oceania		-2.422*** (-6.18)		-2.417*** (-17.13)
_cons	-7.730*** (-18.85)	18.37*** (48.47)	-7.604*** (-10.78)	18.37*** (193.60)
Time Fixed Effects	No	No	Yes	Yes
Cluster By PF	No	No	Yes	Yes
Observations	160	2538	160	2538
Adj. R-Squared	0.9623	0.3754	0.9623	0.3754

Moreover, I find a positive relationship between fees and hedge fund return and a negative relationship between funds-of-funds and fees but the coefficients are not significant in both cases so I cannot draw conclusions.

Hedge fund allocation and fees have a significant positive relationship; a 1% increase in hedge fund allocation leads to a 7.9% in management fees, which seems reasonable since the more the pension funds invest in hedge funds the more management fees pay in total.

Pension fund return has a negative relationship with the management fees, but this relationship does not hold when time fixed effects and clusters are used so I cannot draw conclusions for the fourth hypothesis that *Pension fund return has a negative relationship with fees paid to hedge funds.*

All the regional dummies (USA, Europe and Oceania) have negative and significant coefficients with the management fees. European pension funds seem to pay less management fees; 1% increase leads to 5.32% decrease in management fees. For the USA and Oceania is 2.96 and 2.4% respectively.

5. Conclusion and Limitations

5.1 Conclusion

This paper investigates the investments in hedge funds using an initial international sample that consists of the 264 largest pension funds. Though a relatively new asset class, it has drawn substantial attention by market participants. Over the last decade, pension funds have been investing an increasing portion of their assets under management to hedge funds in order to diversify and achieve uncorrelated returns relative to the market. The median allocation to hedge funds in the sample is 5% but the last three year pension funds allocate around 10% of their assets to hedge funds.

For the research, four hypothesis are analyzed. The first hypothesis which states that larger pension funds allocate more to hedge funds is accepted, the third is rejected since the manager tenure has a positive relationship with the fund performance, whereas I cannot draw concrete conclusions for the second and fourth hypothesis, whether pension funds perform better when they invest in hedge funds and whether Pension fund return has a negative relationship with fees paid to hedge funds, because the relationships do not hold when I cluster by pension fund.

The main findings of the research are that larger pension funds and those located in U.S. allocate more assets to hedge funds. Moreover, larger pension funds tend to invest less to funds-of-funds and pay more investments fees, probably because they invest more in this asset class. Another finding is that pension fund size has a negative relationship with its performance, indicating that they earn lower total returns compared to their smaller counterparts. Finally, manager tenure has a positive relationship with the hedge fund returns; experienced managers deliver higher returns.

5.2 Limitations

There are several limitations regarding the research. First, there is a number of pension funds in the sample that does not report its investments to hedge funds. They mention that they invest in this asset class but they do not indicate the names of the hedge funds or the names of the firms. These pension funds are not included in the final sample. Second, there are some limitations regarding the merging of the data with the MorningStar database. Not all of the pension funds report the name of the hedge funds they invest in but some mention only the firm name; therefore the data cannot be merged since a firm has numerous of funds and it is hard to identify the specific funds that pension funds invest in. In addition, only the active hedge funds from MorningStar database are merged; hence there is no information about the inactive hedge funds in the sample. Third, the performance data on hedge fund level is not included in the dataset.

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7. Appendix

Pension Funds

Alameda County Employees' Retirement Association	Employees' Retirement System of Rhode Island
Alaska Public Employees' Retirement System	Employees' Retirement System of Texas
Alaska Teachers' Retirement System	Employees' Retirement System of the City of Milwaukee
Anne Arundel County Retirement System	Employees' Retirement System of the State of Hawaii
AP Fonden 1	Employees' Retirement System of Baltimore County
Arbejdsmarkedets Tillægspension (ATP)	Fairfax Educational Employees' Retirement System
Arizona Public Safety Personnel Retirement System	First State Super
Arkansas Public Employees' Retirement System	Florida State Board of Administration
Arkansas Teacher Retirement System	Fresno County Employees' Retirement Association
Austin Police Retirement System	Greater Manchester
Baltimore City Employees' Retirement System	Houston Municipal Employees' Pension System
Baltimore Fire & Police Employees' Retirement System	Houston Police Officers' Pension System
British Coal Staff Superannuation Scheme	Illinois Municipal Retirement Fund
British Columbia Investment Management	Illinois State Board of Investment
Caisse de dépôt et placement du Québec	Imarinen
California Public Employees' Retirement System (CalPERS)	Indiana PERF
Cbus	Iowa Public Employees' Retirement System
Chicago Park Employees' Annuity & Benefit Fund	Ireland Strategic Investment Fund
Chicago Transit Authority Employees Retirement Plan	Kentucky Retirement Systems
City of Miami Fire Fighters' & Police Officers' Retirement Trust	Kentucky Teachers' Retirement System
City of Phoenix Employees' Retirement System	Kern County Employees' Retirement Association
City of Zurich Pension Fund	Keva
Colorado Fire and Police Pension Association	Laborers' & Retirement Board Employees' Annuity & Benefit Fund of Chicago
Cook County Pension Plan	Los Angeles County Employees' Retirement Association
Dallas Police & Fire Pension System	Maine Public Employees' Retirement System
Denver Employees' Retirement Plan	Manchester Employees Contributory Retirement System
District of Columbia Retirement Board	Maryland State Retirement and Pension System
Elo Mutual Pension Insurance	Massachusetts Pension Reserves Investment Management Board

Merced County Employees' Retirement Association	Richmond Retirement System
Michigan Department of Treasury	Sacramento County Employees' Retirement System
Milwaukee County Employees' Retirement System	San Bernardino County Employees' Retirement Association
Missouri Department of Transportation & Patrol Employees' Retirement System	San Diego County Employees Retirement Association
Missouri Local Government Employees Retirement System	San Joaquin County Employees' Retirement Association
Missouri State Employees' Retirement System	San Jose Federated City Employees' Retirement System
Montgomery County Employees' Retirement System	San Jose Police and Fire Department Retirement Plan
Municipal Employees' Annuity & Benefit Fund of Chicago	San Mateo County Employees' Retirement Association
Municipal Fire and Police Retirement System of Iowa	School Employees' Retirement System of Ohio
New Hampshire Retirement System	South Carolina Retirement System Investment Commission
New Jersey State Investment Council	South Carolina Retirement Systems
New York City Employees' Retirement System	South Dakota Investment Council
New York City Police Pension Fund	Spokane Employees' Retirement System
New York State Common Retirement Fund	St. Paul Teachers' Retirement Fund Association
New Zealand Superannuation	State of Connecticut Retirement Plans and Trust Funds
Ohio Public Employees' Retirement System	State of Delaware Board of Pension Trustees
Ohio State Highway Patrol Retirement System	State Pension Fund (Finland)
Oklahoma City Employees Retirement System	State Teachers' Retirement System of Ohio
Oklahoma Police Pension and Retirement System	State Universities Retirement System of Illinois
OPSEU	Sunsuper
Orange County Employees' Retirement System	Teacher Retirement System of Texas
Oregon Public Employees Retirement System	Teachers' Retirement System of the State of Illinois
Pennsylvania Public School Employees' Retirement System	Telstra Super
Pennsylvania State Employees' Retirement System	The Royal Bank of Scotland Group Pension Fund
Philadelphia Board of Pensions & Retirement	Town of Palm Beach Retirement System
PK Post	Tulare County Employee Retirement Association
Policemen's Annuity and Benefit Fund of Chicago	Varna
Public School Retirement System of Missouri	Virginia Retirement System
Public School Retirement System of the City of St. Louis	West Virginia Investment Management Board
Public School Teachers' Pension & Retirement Fund of Chicago	Wyoming Retirement System
QSuper Superannuation	