Pension funds' allocations to hedge funds: an empirical analysis of US and Canadian defined benefit plans *

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Abstract

This paper investigates the characteristics of US and Canadian pension funds that allocate assets to hedge funds. The typical pension fund that invests in hedge funds is a large sophisticated pension fund that diversifies its portfolio across numerous classes of investments, private equity in particular, uses a core-satellite organization and has access to low delegation costs for alternative assets. Moreover, we find that pension funds investing in hedge funds significantly obtained higher global returns.

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1 Introduction

Since 2000, institutional investors have been improving their portfolio diversification and allocating more funds to alternative assets.[1] In particular, hedge fund investments became a significant asset class in the portfolios of numerous institutional investors. In 2007, institutional investors accounted for more than 50% of hedge funds inflows for the first time (Mac Kinsey, 2007); the largest share of hedge funds' capital has historically come from high net worth individuals (Prequin, 2009; US GAO, 2008). Pension funds and funds of funds are the main contributors to this change in the client structures of hedge funds.[2]

In this paper, we investigate the characteristics of pension funds that invest in hedge funds. The growing interest that pension funds have taken in hedge funds occurs in a global context. After the stock market crash of 2001-2002 and the decline in long term interest rates, pension funds have been looking for sources of higher returns.[3] Consequently, pension funds steadily reorganized their management to improve their strategic asset allocation. They employ a core-satellite organization, which comes from asset-liabilities management (Sharpe and Tint, 1990). This structure is known to be an efficient strategy for portfolio diversification through active management (Amenc et al., 2004). It consists of defining a strategic asset allocation and dividing assets between two components: core and satellite. The first (75%-90%) aims to match the liabilities of pension funds via immunization techniques. The objective is to avoid risks related to the variability of the assets of pension funds. The core is generally invested in traditional asset classes in liquid markets (large caps, bonds, etc.) and the assets can be managed in either an active or passive way, as well as internally or externally. The second component (10%-25%) is almost exclusively invested in alternative assets (real estate, hedge funds, private equity, infrastructure, etc.). The satellite looks for higher performance (by generating positive *alpha* returns) and a better diversification of risk (by improving *beta*).[4] In addition, satellites are exclusively managed externally because

[1] Alternative assets are made up of private equity, real assets and hedge fund investments.

[2] Funds of funds are collective investment vehicles that allocate assets to several hedge funds to benefit through a diversification of benefits. As a general rule, they are managed by private banks, mutual funds or institutional asset managers.

[3] The high returns earned by hedge funds in bear markets between 2001 and 2003 explain the importance of hedge funds inflows over these years.

[4] Alternative investments allow a portfolio diversification because their return drivers differ from the equity

these active investments require specific expertise that pension funds do not have in-house. The hedge funds industry, with its objectives of high and allegedly uncorrelated returns, seemed therefore particularly attractive for the satellite component.

Regulators viewed hedge funds as having a positive influence on financial markets (Danielsson and Zigrand, 2007). However, their light regulation and their specific governance raise issues beyond those posed by traditional investments. These issues include risks and challenges related to valuation, leverage, liquidity and the operational risk of hedge fund investments (US GAO, 2010). Indeed, investors in hedge funds have limited information on the valuation of and the assets underlying their investments. Hedge funds are engaged in complex investment techniques that can involve various financial instruments for which there is no benchmark and no market. In addition, hedge funds often have broad latitude to use leverage, which amplifies both potential gains and losses. As a result, some of the most successful hedge fund strategies display a vulnerability to extreme losses, i.e., negative skewness and very large kurtosis (Amin and Kat, 2002; Agarwal et al, 2004; Khanniche, 2008). Hedge funds also have specific rules that limit an investor's ability to redeem an investment for a defined period of time; generally corresponding to a one year lockup period. Additionally, hedge funds impose higher fees.[5] As a result, investors need to earn a higher gross return to achieve a higher net return (Ackermann et al., 1999). Finally, a hedge fund's active or risky trading activity may result in losses due to operational failures such as trading errors or outright fraud (operational risk).

The particulars of hedge fund investments -related mainly to valuation, leverage, liquidity and operational risk- imply that many pension funds do not have the necessary abilities or incentives to invest in this category of alternative assets. Investments in hedge funds should, for example, be made by those with the skills required to select hedge funds managers and require sufficient bargaining power to negotiate contractual terms related to fees and information disclosure.

Attention had increasingly focused on the management and investment practices of pen-

and bond markets drivers (Schneeweis, Kazemi and Martin, 2001).

[5]Investors are charged 3 types of fees: management fees (1%-2%), performance fees (15%-20%) and early termination fees (1%-2%) in the event of an early liquidation.

sion funds. However, few studies focus on pension funds' contractual delegation to their hedge fund managers. This paper aims to bridge this gap through the use of an original and representative database from CEM benchmarking. This database concerns the investment strategies of US and Canadian Defined Benefits pension funds, over the period 2000-2008. The first aim of this article is to analyze the extent to which US and Canadian pension funds allocate to hedge funds and to identify the main characteristics of the pension funds investing in hedge funds. Second, we investigate the implications of allocating pension fund assets to hedge funds. More precisely, we propose to evaluate the benefits of hedge fund investments with respect to returns and to question to what extent pension funds have tackled specific agency problems in their delegation to hedge funds.

The remainder of the paper is organized as follows. Section 2 presents the data and descriptive statistics. Section 3 assesses the characteristics of the pension funds allocating to hedge funds. Section 4 investigates the relationship between pension funds' global returns and their allocation to hedge funds. Section 5 concludes the paper.

2 Dataset and descriptive statistics

We use the CEM benchmarking database, which provides data on individual defined benefit pension plans from the US and Canada from 1990 to 2008. The data include assets under management (in millions of dollars); costs and returns, which are available by asset class and by the nature of their delegation (active/passive and external/internal).[6] In addition, the database provides the policy asset allocations (in %) (i.e., strategic asset allocations, defined before buy and sell decisions) and their expected return by asset class as well as other information regarding global costs (custody, consulting and oversight). The database also indicates whether the fund is publicly or privately owned.

According to Mac Kinsey (2007), OECD (2008) and US GAO (2008), US defined benefit (DB) pension funds were valued at $4,250 billion in 2007.[7] Assets under the management

[6]Total assets are disaggregated into 7 classes: equity, fixed income, real assets, private equity, hedge funds, cash and tactical asset allocation (TAA). In addition, for assets under management, equities and fixed income assets are also disaggregated into subclasses.

[7]More precisely, total assets managed by US pension funds amounted to $9,500 billion in 2007 and

of the US pension funds listed in the CEM benchmarking database accounted for $2,500 billion in 2007, i.e., around half the value of US DB pension funds in terms of assets under management. Concerning Canada, more than 93% of pension funds were defined benefit in 2004, while their assets under management amounted to about $700 billion in 2006 (OECD, 2007). The CEM benchmarking database seems to be representative, as it reports that $460 billion of assets were under management in 2006.

We focus our empirical analysis on the period from 2000 to 2008 because pension funds began allocating to hedge funds in 2000.[8] More precisely, we have an unbalanced panel of 1,973 observations for 407 pension funds, among which 86 invested in hedge funds for at least one period. Concerning the geographic distribution, 274 pension funds in our dataset come from the US, and 72 of these US pension funds invested in hedge funds for at least one period. To our knowledge, the information provided by the CEM benchmarking database concerning allocations to hedge funds has rarely been used in related pension fund studies.[9]

In this section, we present general descriptive statistics concerning pension funds' allocations to hedge funds. In addition, we suggest several characteristics of pension funds that could be related to the decision to invest in hedge funds.

2.1 Allocation to hedge funds

Table 1 shows the average portfolio allocation for the full sample and for the subsample of pension funds investing in hedge funds. In the full sample, equities are the primary assets and account for approximately 60% of the portfolio, followed by fixed income assets, which represent approximately 30% of the portfolio. The remainder of the portfolio is allocated to alternative assets, mainly real assets (approximately 4%) and private equity (approximately 3%). Allocations to hedge funds only represent 0.61%, indicating both that numerous pension funds do not invest in hedge funds and that pension funds consider the three categories

approximately half of those assets were managed by DB pension funds.

[8] There is no distinction in the database between allocations to hedge funds or to funds of hedge funds.

[9] For example, French and Kenneth (2008) compare the fees, expenses and trading costs society pays to invest in the U.S. stock market along with an estimate of what would be paid if everyone invested passively. Bauer, Cremers and Frehen (2010) document the performance and costs of the domestic equity investments of a large sample of US pension funds (small-large size) in comparison with mutual funds.

of alternative assets differently. Focusing on the subsample of pension funds investing in hedge funds, Table 1 highlights how the portfolio allocation is modified when pension funds decide to invest in hedge funds. The average allocation to hedge funds jumps to 4.57%. The allocation to other alternative assets also increases. Real assets and private equity represent 6.16% and 4.98% of total assets respectively. These reallocations are made through a reduction in equities, which account for 52.52% of total assets.

To illustrate more precisely the pension funds' allocations to hedge funds ($HF_{i,t}$), Figure 1 represents the percent distribution of $HF_{i,t}$ for the subsample of pension funds investing in hedge funds. For more than 50% of these pension funds, investments in hedge funds represent less than 3% of total assets. However, several pension funds are investing more than 10% of their total assets in hedge funds with a maximum of 36.69%. In the US, the federal government does not specifically limit or monitor private sector defined benefit plans investments in hedge funds, and state approaches to public pension plans vary.[10] Under the Employee Retirement Income Security Act (ERISA) of 1974, fiduciaries (pension fund administrators) must comply with a standard of prudence (including the diversification of assets and minimizing the risk of large losses), but there is no explicit restrictions on allocations to hedge funds. The prudent man standard does not explicitly prohibit investment in any specific category. An unsuccessful individual investment is not considered a per se violation of the prudent man standard.

Table 2 gives a breakdown of the number of pension funds by year in the full sample. In addition, Table 2 displays the proportion of pension funds investing in the three categories of alternative assets and the average allocation. The number of pension funds investing in hedge funds has increased over the years. From 2000 to 2008, the percent of pension funds investing in hedge funds increased from 1.35% to 25.42%. However, the average allocation has not increased over time. Real assets and private equity are more commonly managed by

[10] We can classify pension funds by two criteria that can be mixed: the first is concerned with benefits, which can be defined or not; the second relates to sponsorship, which can be private or public. A defined benefit (DB) plan promises participants a specified monthly benefit at retirement. In this context, plan sponsors bear the investment risk. On the contrary, a defined contribution (DC) plan does not promise a specific amount of benefits at retirement. In addition, public and private DB plans are not subject to the same regulatory framework. The federal government monitors private sector DB plan investments and state governments monitor the investments of public DB plans.

pension funds. From 2000 to 2008, the percentage of pension funds investing in real assets increased from 69.68% to 78.81%. Concerning private equity, the percentage increased from 51.13% to 63.98%. Similar to investments in hedge funds, the average allocations do not exhibit a trend.

The interest of pension funds in hedge funds may also be highlighted by the strategic allocation, also known as the policy weight ($PW_{i,t}$). Table 3 reports some descriptive statistics for several variables used in our empirical analysis. The average policy weight of hedge funds is higher than the effective allocation ($HF_{i,t}$) and reaches 1.03% in the full sample. Focusing on the subsample of pension funds investing in hedge funds, the policy weight and the effective allocation seem very close on average, at 4.62% and 4.57% respectively. However, the policy weight and the effective allocation can diverge noticeably. Several pension funds investing in hedge funds report a policy weight equal to 0, and conversely, several pension funds reporting a positive policy weight do not invest in hedge funds. For example, the policy weight is equal to 0 for 36% of the subsample of pension funds investing in hedge funds.[11] As a result, the policy weight of hedge funds can provide a distorted representation of the effective investments pension funds make in hedge funds. Therefore, we focus our empirical analysis on the effective allocation ($HF_{i,t}$) rather than on the policy weight ($PW_{i,t}$).

2.2 Sophistication of pension funds

Hedge funds represent one category of alternative assets in which pension funds invest. Real assets and private equity are the two other categories. Private equity funds are funds specializing in funding innovation via corporate creation (venture capital), growth of small and mid-sized firms (expansion) and the purchase of diverse firms (leverage buyouts). Real assets include real estate investment trusts (REITs), real estate, commodities and infrastructure (mainly for corporations offering public services, e.g., natural monopolies).

Table 3 reports the percentages of private equity ($PRIV_{i,t}$) and real assets ($REAL_{i,t}$) in total assets as well as the sum of these two components ($ALT_{i,t}$). The average of $ALT_{i,t}$

[11] In addition, considering the subsample where $PW_{i,t} > 0$ (315 observations), the average policy weight is 6.49%, the average effective allocation is 2.57% and 46% of observations in this subsample have an effective allocation equal to 0.

is 6.45% in the full sample and 11.15% for pension funds investing in hedge funds. The averages suggest therefore that pension funds that invest more in private equity and real assets have the increased incentives or skills to invest in hedge funds.

The degree of sophistication of pension funds can be evaluated more generally through different indicators. De Dreu and Bikker (2009) suggest that the home bias in asset allocation reveals the "degree of shortsightedness" of investors. International diversification in investment allocation could, therefore, be positively associated with the degree of sophistication of pension funds. International diversification ($FOR_{i,t}$) is measured by the percentage of foreign equities in the equity portfolio. Foreign equities represent 37.64% of the equity portfolio in the full sample and 43.44% for pension funds investing in hedge funds (Table 3). Pension funds with a lower home bias tend to invest more in hedge funds.

Policy weight could also be informative with respect to the identification of sophisticated funds. Figure 2 represents the percent distribution of policy weights for equities. Policy weights are frequently a multiple of 5%. More precisely, the policy weight for equities is fixed at 55%, 60%, 65% or 70% for more than 40% of our sample. De Dreu and Bikker (2009) suggest that the use of these attractive numbers reveals a lack of a sophisticated method of selecting investments. Indeed, asset allocation models should give an accurate number, while rounding to the nearest 5% indicates the use of human judgment. We create the dummy variable $RND_{i,t}$, which takes the value one if the policy weight for equities is a multiple of 5% and zero otherwise. In the full sample, approximately 50% of the observations round their equity policy weights. In the subsample of pension funds investing in hedge funds, this percentage is reduced to 30%, which could indicate that pension funds using an accurate method to choose equity policy weights also tend to invest in hedge funds.

We consider a final indicator of sophistication based on performances in traditional asset classes, i.e., in fixed incomes and equities. All pension funds hold traditional assets, which can be managed actively or passively and externally or internally.[12] According to the smart money effect, sophisticated investors make smart choices to identify funds that subsequently perform well. As a result, decisions made by sophisticated pension funds should lead on

[12]Passive management corresponds to indexed management and external management corresponds to delegated management to a third asset manager.

average to better performances in the core component. We compute a dummy variable SF_i that takes the value one if the pension fund has an average return (net of delegation costs) in the core component higher than the average obtained for the full sample. By definition, approximately 50% of pension funds are classified as sophisticated in the full sample using variable SF_i.[13] In the subsample of pension funds investing in hedge funds, this percentage rises to 58%. The descriptive statistics provide evidence that funds that are smart in the core component also tend to invest in hedge funds.

2.3 Portfolio management

Portfolio management is noticeably different across pension funds. Practices regarding delegation and diversification can highlight these differences. Ownership and size can also affect portfolio management, specifically concerning preferences about allocations to hedge funds.

The management can be active or passive and external or internal. In our dataset, pension funds generally manage their assets through external and active management. Table 3 shows that the percentage of assets under external and active management ($EA_{i,t}$) represents on average approximately 70% of total assets, both in the full sample and in the subsample of pension funds investing in hedge funds. Consequently, the descriptive statistics do not exhibit a clear link between preferences regarding delegation and allocation to hedge funds.

The degree of diversification is assessed by the sum of the squares of the percentage asset allocations ($DIV_{i,t}$).[14] This measure is computed in the spirit of a Herfindahl index. Table 3 shows that the variable $DIV_{i,t}$ is on average lower for pension funds investing in hedge funds (0.17) than in the full sample (0.23). As a result, pension funds pursuing a higher portfolio diversification invest more in hedge funds.

Pension funds are owned either publicly or privately. In the full sample, 259 pension funds (out of 407) are owned privately, i.e., approximately 60% of the pension funds in the

[13] This is not exactly 50% because the dataset is not balanced.

[14] Total assets are divided into 7 categories (equity, fixed income, real assets, private equity, hedge funds, cash, TAA) and each category can be subsequently disaggregated into 3 dimensions at most: (*i*) a subcategory (only for equity and fixed income); (*ii*) internal/external delegation; (*iii*) active/passive delegation. Subcategories refer to a geographical criterion (US, Canada, EAFE, Emerging, etc.) or an asset specificity (high yield bonds, mortgage bonds, etc.).

dataset. A similar division is observed in the subsample of pension funds investing in hedge funds, with 48 pension funds (out of 86) are owned privately. Table 3 reports descriptive statistics for the subsample of private pension funds. These statistics are similar to those obtained for the full sample, which suggests that private and public pension funds share several characteristics. For example, allocation to hedge funds ($HF_{i,t}$) is on average similar in the full sample and in the subsample of private funds. When pension funds invest in hedge funds, the average allocation is 4.57% in the full sample and 4.33% in the subsample of private funds.

The size of investors is frequently informative for an understanding of investment policies. The average of total assets for the pension funds in the full sample is $10,878 million. Pension funds investing in hedge funds are significantly larger with an average of total assets of $22,802 million. Therefore, a size effect could have an effect on the investments pension funds make in hedge funds.

2.4 Costs and returns

Delegation costs for alternative assets under external and active management ($DC_{i,t}^{AEA}$) are particularly high. On average, these delegation costs are 1.77% in the full sample and 1.84% for pension funds investing in hedge funds. Delegation costs for equity ($DC_{i,t}^{E}$), the main asset of pension funds, are around 0.30%. Pension funds therefore face delegation costs 5 or 6 times higher when they decide to invest in alternative assets under external and active management rather than in equity. In addition, the standard deviation of the variable $DC_{i,t}^{AEA}$ is high, suggesting that pension funds do not face similar conditions when investing in alternative assets.

These prohibitive costs can be explained by several factors. Most hedge funds strategies use high trading volume with a great deal of operational support and incur important research (front office) costs. Moreover, hedge funds are often small entities with few employees (Cumming and Dai, 2007). They are typically called "boutiques". Hedge funds managers are therefore more eager to concentrate their efforts on the front office tasks (to benefit from opportunities) than administrative tasks. Hedge funds tend to delegate other operations to specialized services providers (administration, IT, back office, middle office, compliance

services, legal services, etc.). These services do not require the particular expertise of hedge funds managers. They are more the business of investment bankers. This increasing externalization of supporting services/activities has two consequences: an increase in the costs of delegation management and more difficult monitoring resulting from a lengthening of the investment channel with more numerous intermediates (see KPMG (2008) for a survey of hedge fund cost structures).

Table 3 shows that the average return from hedge fund investments ($R_{i,t}^{HF}$) is 2.41%. However, the average value results from volatile returns; the standard deviation is very high. For example, the average return reached 12.73% in 2003 and fell to -16.25% in 2008.

3 Characteristics of pension funds allocating in hedge funds

The characteristics of the pension funds investing in hedge funds are identified with a Tobit model. Numerous pension funds do not invest in hedge funds and the Tobit model allows us to account for the censoring of the data. We consider the different variables stated in the previous section as explanatory variables.

3.1 Empirical framework

We consider the following empirical specification[15]:

$$HF_{i,t} = \begin{cases} HF_{i,t}^{*} \text{ if } HF_{i,t}^{*} > 0 \\ 0 \text{ otherwise} \end{cases} \tag{1}$$

with:

$$HF_{i,t}^{*} = \alpha_i + \gamma_{j,t} + \mathbf{X}_{i,t}'\boldsymbol{\beta} + \varepsilon_{i,t}, \tag{2}$$

where $\alpha_i \sim N(0, \sigma_\alpha^2)$ is a time-invariant individual random effect, $\gamma_{j,t}$ is a country-and-time fixed effect, $\mathbf{X}_{i,t}$ is the regressor vector (including an intercept), $\boldsymbol{\beta}$ is a vector of unknown

[15] The subscript i indexes pension funds, t indexes years and j indexes countries (Canada or the US). For simplicity, the subscript j is used only for the country-and-time fixed effect.

parameters and $\varepsilon_{i,t} \sim N(0, \sigma_\varepsilon^2)$ is a time-varying idiosyncratic random error. The regressor vector is given by: $\mathbf{X}'_{i,t} = [PRIV_{i,t-1} \;\; REAL_{i,t-1} \;\; FOR_{i,t} \;\; RND_{i,t} \;\; SF_i \;\; EA_{i,t-1} \;\; DIV_{i,t} \;\; TYP_i \;\; SIZE_{i,t-1} \;\; DC_{i,t}^{AEA} \;\; R_{i,t-1}^{HF} \;\; C]$ where C is the intercept and TYP_i is a dummy variable that takes the value 1 if the pension fund is publicly owned and 0 otherwise. Variables $PRIV_{i,t-1}$, $REAL_{i,t-1}$, $EA_{i,t-1}$ and $SIZE_{i,t-1}$ are included with a lag to avoid simultaneity and endogeneity problems. Furthermore, we compute the variance inflation factors (VIF) to assess whether there is a collinearity problem between the regressors. The average VIF is 1.30 and the maximum is 1.78, which suggests that the regressors are independent.

The model is first estimated with the random-effects maximum likelihood estimator (MLE).[16] This estimator assumes that random effects are independent of the regressors. This assumption is relaxed with the Mundlak (1978) correction, which supposes that unobserved heterogeneity is a function of the means of the regressors. In a second specification including the Mundlak (1978) correction, random effects are defined as:

$$\alpha_i = \bar{\mathbf{X}}'_i \boldsymbol{\pi} + \boldsymbol{\omega}_i, \tag{3}$$

where $\boldsymbol{\pi}$ is a vector of unknown parameters and $\boldsymbol{\omega}_i \sim N(0, \sigma_{\boldsymbol{\omega}}^2)$ is a time-invariant individual random effect. Equation (3) allows us to tackle the correlation between unobserved effects and the regressors in the Tobit framework.

The estimated coefficients measure the marginal effect of the independent variable on the latent variable ($HF_{i,t}^*$). We also report the marginal effects for the expected value of the dependent variable conditional on it being uncensored. Considering the marginal effects of the regressors on the observed variable ($HF_{i,t}$) allows for a quantitative interpretation of the results.

3.2 Results

Results are displayed in Table (4). Specification (**1.a**) corresponds to the estimations of Equation (2) with the random-effects MLE. In specification (**1.b**), the Mundlak (1978) correction is included. Including the Mundlak correction does not modify the conclusions.

[16] In short panels, the fixed effects MLE is inconsistent (see Cameron and Trivedi (2005)).

First, allocations to private equity and real assets do not affect the allocation to hedge funds in the same way. The results show a positive and significant relationship between private equity ($PRIV_{i,t-1}$) and hedge fund allocations, while real assets ($REAL_{i,t-1}$) do not have a significant effect. More precisely, the estimated marginal effects in Table (4) from specification (**1**.**b**) show that a 1% increase in the private equity allocation leads to a 0.059% increase in the hedge fund allocation. This result highlights the fact that private equity and hedge funds have similarities. More and more hedge funds are turning to a specific investment style: event driven, which is a strategy very similar to that used in private equity. Indeed, event driven strategies involve long or short term investments in the securities of corporations undergoing significant change (e.g., spin-offs, mergers, liquidations and bankruptcies). Such changes often provide managers with a tangible catalyst by which the manager may be able to perceive the expected change in value in the underlying security. Substantial profits may be generated by managers who correctly analyze the impact of the anticipated corporate event, predict the course of restructuring and take positions accordingly. In 2010, the event driven strategy was that used the most frequently by hedge fund managers (HFR, 2010). The difference between hedge funds and private equity is becoming increasingly blurred. Consequently, hedge funds and private equity occupy a particular place in the class of alternatives. They are considered to be more risky strategies than real assets are. Pension funds that invest in real assets are less interested in superior returns than in protection against inflation because pension benefits are in real terms (Alestalo and Puttonen, 2005). Real assets tend to be placed among the traditional asset classes. According to the definition used by CEM Benchmarking, real assets are included in real estate and infrastructure. These assets incorporate bond and stock characteristics because of rent and right of use, respectively, and by the variation in asset value.

Second, concerning sophistication indicators, we find a positive and significant effect for the variable $FOR_{i,t}$ (related to home bias) and SF_i (related to performance in the core component), while the use of attractive numbers in the policy weights (the variable $RND_{i,t}$) does not have a significant impact at the 10% level. As a result, sophisticated pension funds characterized by a lower home bias and better performance in traditional assets invest more in hedge funds. More precisely, the estimated marginal effects for specification (**1**.**b**) show

that a 1% increase in the proportion of foreign equities in the equity portfolio leads to a 0.010% increase in hedge fund allocations. Smart pension funds, identified by the variable SF_i, invest 0.488% more in hedge funds. Additionally, contrary to what one might expect from the descriptive statistics, unsophisticated pension funds that round their policy weights are not significantly less involved in hedge funds. De Dreu and Bikker (2009), who investigate strategic bond allocations (i.e., in unsophisticated assets) for Dutch pension funds, find that this indicator is relevant to explanations of the behavior of pension funds.

Third, several variables related to the portfolio management significantly affect allocation to hedge funds. Pension funds that are more involved in external and active delegation ($EA_{i,t-1}$) and more diversified ($DIV_{i,t}$) invest significantly more in hedge funds. For example, the estimated marginal effects for specification (**1**.**b**) show that a 1% increase in the proportion of assets under an external and active delegation leads to a 0.016% increase in hedge fund allocations. The positive effect of variable $EA_{i,t-1}$ might result from the adoption of core-satellite management by pension funds beginning in 2000 and a particular interest in hedge funds in the satellite component. Furthermore, we find a size effect. The variable $SIZE_{i,t-1}$ has a positive and significant effect. The estimated marginal effects for specification (**1**.**b**) show that hedge fund allocations increase by 0.342% when the log of total assets increases by 1. This result confirms that management delegation in alternative assets implies a long and costly process of selecting hedge funds or a style of hedge funds. Large pension funds are therefore in a better position to invest in hedge funds (Rigot and Tadjeddine, 2010). Finally, concerning ownership, the coefficient of variable TYP_i is not significant at the 10% level. The flexible prudent man rule is more and more frequently applied by public pension funds, even though some restrictive quantitative rules remain. This trend could explain why we do not find differences between the regulatory frameworks for public and private pension funds.

Lastly, the descriptive statistics showed that delegation costs for alternative assets under external and active management ($DC_{i,t}^{AEA}$) are particularly high on average. We find that this variable has a negative and significant coefficient. This result suggests that costs matter for allocations to hedge funds. Conversely, past performance does not seem relevant. The lagged return from hedge fund investments ($R_{i,t-1}^{HF}$) does not have a significant effect. The estimated

marginal effects in specification (**1**.**b**) show that a 1% increase in variable $DC_{i,t}^{AEA}$ leads to 0.105% decrease in hedge fund allocations. Pension funds with lower management costs invest more in hedge funds. We can presume that some pension funds are more able to negotiate these costs for alternative assets.[17] Indeed, focusing on hedge funds, the contract between hedge fund managers and their investors is specific (concerning for example information disclosures, liquidity conditions and performance fees). There is no standardized contract because hedge funds are not regulated like the other mutual funds. In the name of the importance of contractual freedom, contractual terms are mainly defined by co-contractors. Consequently, the degree of transparency, liquidity and the terms of performance are the result of the balance of power between hedge fund managers and pension fund administrators. In this contractual framework, some pension funds can demand more relevant and detailed information and negotiate contractual terms related to fees. For example, large pension funds naturally have a greater bargaining power (Rigot and Tadjeddine, 2010). However, the subprime crisis has revealed that this balance of power was rather in the hedge funds' favor. Indeed, until the crisis, pension funds tended to trust their hedge fund managers (e.g., they did not negotiate contractual terms or require the disclosure of information disclosures) as long as the hedge fund's performance was high and decorrelated. This passive behavior prevents pension funds from making a good risk evaluation, and may be prejudicial because pension funds are institutional investors that collect savings from employees (final investors) to pay long term retirement benefits. The large losses registered by pension funds in their hedge fund allocations in 2008 have induced mistrust and have incited pension funds to negotiate lower fees, shorter lockup periods and more informational disclosures as well as the use of independent service providers to monitor returns (Shabad, 2009).

In conclusion, the typical pension fund that invests in hedge funds is a large private sophisticated pension fund that diversifies its portfolio across numerous classes (in private equity in particular), uses core-satellite organization and has access to low delegation costs for alternative assets. Now that we have identified the characteristics of the pension funds allocating to hedge funds, we can consider the potential benefits of this allocation.

[17] Bikker and De Dreu (2009) find that economies of scale exist for largest pension funds with regard to investment costs.

4 Returns and allocation to hedge funds

We investigate the relationship between the global returns obtained by pension funds and their allocations to hedge funds.

First, we could expect a direct effect. Investments in hedge funds are made both to generate positive "alpha returns" and for asset diversification, which could lead to a positive effect on global returns. However, the high costs that pension funds incur by investing in hedge funds and the relatively low allocations to hedge funds might weaken this relationship. Indeed, hedge funds have specific governance (i.e., contractual terms) with their investors. Moreover, they purportedly generate alpha returns via complex strategies and the use of financial instruments that are not allowed for mutual funds, such as leverage and short selling. Consequently, these investments are more risky and more expensive.

Second, we could also expect an indirect effect. As stated in the descriptive statistics and in the previous section, pension funds investing in hedge funds are more diversified, more sophisticated and larger. All the beneficial aspects these characteristics have on global returns could be captured through allocation to hedge funds.

4.1 Empirical framework

We consider the following empirical framework:

$$R_{i,t} = \varphi_1 HF_{i,t} + \varphi_2 TYP_{i,t} + \delta_{j,t} + \eta_i + u_{i,t} \tag{4}$$

where $R_{i,t}$ is the global net return obtained from the whole portfolio, $\delta_{j,t}$ is a country-and-time fixed effect, η_i is a time-invariant individual effect and $u_{i,t} \sim N(0, \sigma_u^2)$ is a time-varying idiosyncratic random error.[18] The Hausman test is implemented to determine if η_i should be considered as an individual fixed-effect or as an individual random effect.

Equation (4) allows us to test if allocation to hedge funds has a significant effect on the global return after controlling for ownership ($TYP_{i,t}$), country-and-time ($\delta_{j,t}$) and individual

[18] More precisely, $R_{i,t}$ represents the average return minus the average cost obtained from the equity, fixed income, real assets, private equity and hedge fund portfolios.

(η_i) effects. Alternatively, Equation (4) is estimated with the variable $hf_{i,t}$ –a dummy variable that takes the value 1 if the pension fund invests in hedge funds and 0 otherwise– instead of $HF_{i,t}$. Beneficial aspects on global returns could be related to the decision to invest in hedge funds rather than the proportion allocated to hedge funds. Therefore, considering $hf_{i,t}$ instead of $HF_{i,t}$ allows us to identify if the effect of hedge funds on global returns is direct (i.e., related to the proportion allocated) or indirect (i.e., related to the decision to allocate).

The distinction between the direct and indirect effects is also assessed with a modification of the endogenous variable in Equation (4). We define $R'_{i,t}$ as the net return obtained from the sub-portfolio excluding allocations to hedge funds. As a result, considering variable $R'_{i,t}$ instead of $R_{i,t}$ in Equation (4) removes the potential direct effect of the allocation to hedge funds that one might expect. A positive relationship between $HF_{i,t}$ (or $hf_{i,t}$) and $R'_{i,t}$ could only be explained by an indirect effect.

Finally, we consider the net return in the core component ($R^c_{i,t}$) as an endogenous variable to investigate whether pension funds investing in hedge funds outperform other pension funds, even in the core component. Indeed, the ability of pension funds investing in hedge funds to make smart choices in selecting funds also concerns investments in traditional assets.

4.2 Results

Table (5) displays the results obtained with the random effect estimator. The Hausman test indicates that this estimator is consistent. Furthermore, controlling for ownership, country-and-time and individual effects explain the relatively high R^2 value.

Specification (**2**.**a**) in Table (5) shows that allocation to hedge funds ($HF_{i,t}$) has a positive and significant effect on global returns ($R_{i,t}$). The estimated coefficient is 0.1494. In specification (**2**.**b**) the variable $hf_{i,t}$ is used instead of $HF_{i,t}$ identify whether the effect is direct or indirect. We also obtain a positive and significant coefficient. Global returns are, on average, higher for pension funds investing in hedge funds. More precisely, global returns increase by 1.1377%. The beneficial aspects of hedge funds therefore seem to be related to the decision to invest in hedge funds and not especially to the proportion of the allocation.

In specifications (**2**.**c**) and (**2**.**d**), variable $R'_{i,t}$ is used as endogenous variable to con-

firm the importance of the indirect effect. The proportion invested in hedge funds and the decision to invest in hedge funds both have a positive and significant effect on the net returns obtained from the sub-portfolio excluding allocations to hedge funds. In particular, net returns in the sub-portfolio ($R'_{i,t}$) is 1.1894% higher for pension funds investing in hedge funds. Consequently, our results are primarily driven by an indirect effect. Pension funds investing in hedge funds combine several characteristics that improve their returns. This effect illustrates a positive aspect resulting from core-satellite organization and from the sophistication of pension funds. However, the benefit could be higher if pension funds were to adopt stronger governance concerning hedge fund delegation. For example, large pension funds should use their bargaining power to require more disclosures to better evaluate hedge funds risks and lower performance fees. This is already the case for the biggest US DB public pension fund (CalPERS), which announced in 2009 that it would only enter partnerships with hedge funds under these renegotiated conditions.

Finally, in specifications (**2**.**e**) and (**2**.**f**), variable $R^c_{i,t}$ is the endogenous variable. The proportions invested in hedge funds ($HF_{i,t}$) do not significantly affect net returns of the core component ($R^c_{i,t}$). However, we find a positive and significant relationship between the decision to invest in hedge funds ($hf_{i,t}$) and $R^c_{i,t}$. Returns in the core component increase by 1.0067% for pension funds investing in hedge funds. The incentives and skills that lead some pension funds to invest in hedge funds therefore also have positive effects on the pension funds' abilities to outperform in traditional assets. The sophistication of pension funds does not only matter for the selection of funds specializing in alternative assets but for the construction of the core component portfolio as well.

5 Conclusion

Institutional investors have had an increasing interest in hedge funds since the beginning of the 2000's due to their promises of high and decorrelated returns. In this paper, we investigate the characteristics of pension funds allocating to hedge funds, and we question the potential benefits of these specific alternative investments. We find evidence that the typical pension fund investing in hedge funds is a large, sophisticated pension fund that

diversifies its portfolio across numerous classes (in private equity in particular), uses core-satellite organization and has access to low delegation costs for alternative assets. Moreover, our results emphasize the beneficial aspect of investments in hedge funds in terms of returns. This positive effect is more due to the decision to invest in hedge funds than to the size of the allocation or the return on the hedge fund investments. Consequently, this beneficial aspect is mainly driven by an indirect effect. Pension funds investing in hedge funds combine several characteristics that positively affect their returns such as improved diversification.

Recent financial disturbances have shown, however, that hedge funds are not unsinkable. Losses in hedge fund allocations were higher than those allocated to private equity and real assets.[19] Specific agency problems in hedge fund delegation and a certain passivity in the behavior of pension funds could explain this lower performance. Benefits could therefore be higher if pension funds were to adopt stronger monitoring concerning their delegation to hedge funds. Private misallocations induced by such informational asymmetries may have detrimental consequences in the case of pension funds because the retirement benefits of millions of employees are at stake (the consequences include increased contributions and/or decreased benefits).

These issues relating to the lack of transparency in the hedge fund industry were so prominent in the 2007-2009 crisis that regulatory authorities decided to change hedge fund regulations. They recognized that the opacity of hedge funds may lead to predictable damages: misallocations at the micro level and increasing financial instability and systemic risk at the macro level. For the first time since the beginning of the hedge fund industry in the 1950's, draft hedge fund draft regulations were promulgated in the European Union (EU) and the US. The first is specific to hedge funds, while the second is a part of comprehensive US financial reform.[20] In spite of differences in hedge fund regulations between the US and the EU (Rigot and Tadjeddine, 2010), a modification in investors' behavior towards hedge fund managers is all the more crucial, as pension funds continue to allocate to hedge funds.

[19] In 2008, the returns on private equity and real asset allocations were between -5% and 10%.

[20] Directive of the European Parliament and Council on Alternative Investment Fund Managers; (AIFM) Second Proposal with amendments – November 2009 (Gauzes report); Directive of the European Parliament and Council on Alternative Investment Fund Managers (AIFM) Final Proposal – May 2010;

US Treasury financial regulation reform, Geithner Plan (June, 2009); Financial reform, a framework for financial stability, Volcker plan (January 2010); US Financial reform bill, (July 2010)

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Figure 1: Percent distribution of $HF_{i,t}$ for the subsample of pension funds investing in hedge funds

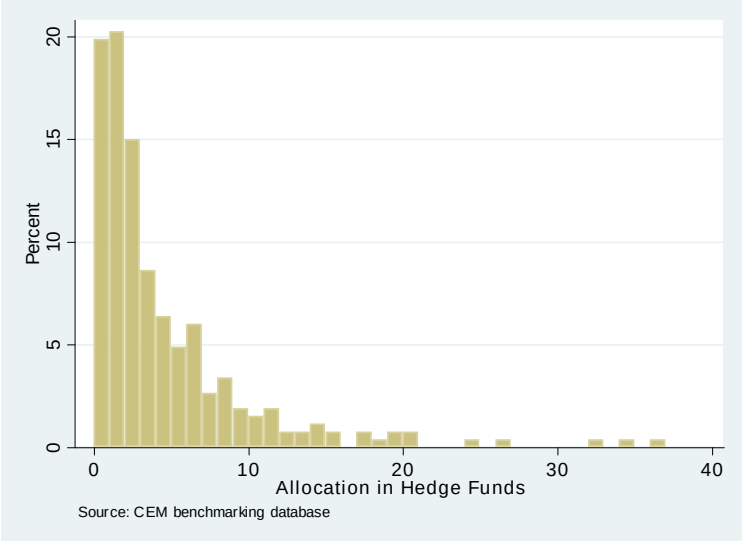

Figure 2: Percent distribution of the equity policy weight for the full sample

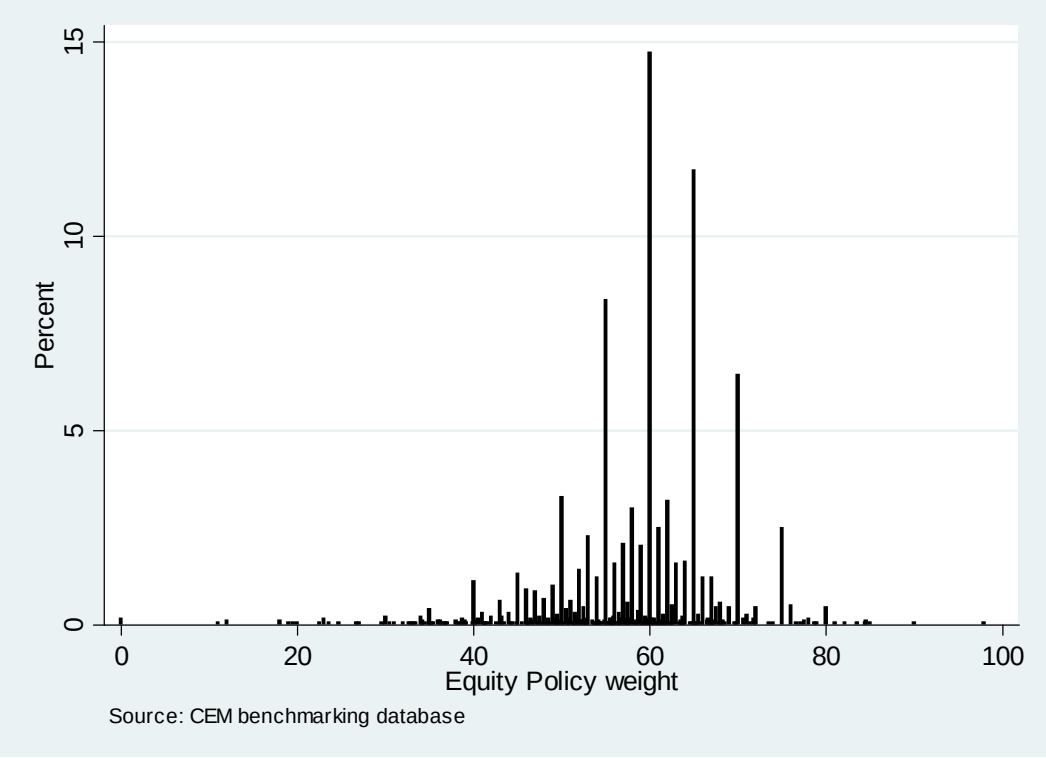

Table 1: Average portfolio allocation (2000-2008)

(% *total assets*)	**Equity**	**Fixed Income**	**Real Assets**	**Private Equity**	**Hedge Funds**	**Other**
Full sample (1976 observations)						
Mean	59.19	31.53	4.01	2.43	0.61	2.19
Standard Deviation	9.91	8.93	4.24	3.68	2.56	3.96
Min / Max	0/96.63	0/89.95	0/26.11	0/22.76	0/36.69	0/39.82
Subsample of pension funds investing in hedge funds (267 observations)						
Mean	52.52	28.81	6.16	4.98	4.57	2.92
Standard Deviation	12.38	10.09	5.05	4.14	5.55	3.98
Min / Max	0/74.00	10.40/84.15	0/26.11	0/18.46	0.01/36.69	0/19.58

Note: Category *Other* merges allocations in cash and TAA.

Source: CEM benchmarking database.

Table 2: Breakdown of pension funds by year

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
No. of Pension Funds	221	228	215	210	223	207	206	230	236
% investing in hedge funds	1.35	3.94	6.97	9.52	11.65	15.94	21.35	24.78	25.42
Average allocation	5.01	5.60	4.41	2.19	3.13	4.77	4.52	4.89	5.47
% investing in real assets	69.68	65.78	65.58	67.61	72.74	72.46	72.81	74.78	78.81
Average allocation	4.00	5.06	5.46	5.24	4.84	5.25	6.01	6.63	7.70
% investing in private equity	51.13	50.00	50.23	52.85	52.91	55.07	56.79	61.73	63.98
Average allocation	4.07	4.52	4.13	4.23	3.94	3.71	3.74	4.71	6.13

Note: *Average allocation* is expressed in % of total assets.

Source: CEM benchmarking database.

Table 3: General descriptive statistics : mean and standard deviation

	Full sample		Subsample of private funds	
	All funds	Funds with $HF_{i,t} > 0$	All funds	Funds with $HF_{i,t} > 0$
$HF_{i,t}$	0.61	4.57	0.61	4.33
	(2.56)	(5.55)	(2.16)	(4.13)
$PW_{i,t}$	1.03	4.62	1.27	5.76
	(3.24)	(6.01)	(3.84)	(6.94)
$PRIV_{i,t}$	2.43	4.98	2.28	5.16
	(3.68)	(4.14)	(3.55)	(4.40)
$REAL_{i,t}$	4.01	6.16	3.06	5.07
	(4.24)	(5.05)	(3.77)	(4.46)
$ALT_{i,t}$	6.45	11.15	5.34	10.24
	(6.48)	(7.21)	(5.91)	(6.91)
$FOR_{i,t}$	37.64	43.44	38.42	40.04
	(15.77)	(17.12)	(16.11)	(13.12)
$EA_{i,t}$	69.35	70.77	73.39	80.08
	(26.75)	(29.39)	(26.11)	(23.46)
$DIV_{i,t}$	0.23	0.17	0.24	0.19
	(0.08)	(0.06)	(0.08)	(0.07)
$TA_{i,t}$	10878	22802	5495	14620
	(23162)	(38083)	(10829)	(21206)
$DC_{i,t}^{AEA}$	1.77	1.84	1.70	1.71
	(2.03)	(1.19)	(1.63)	(1.31)
$DC_{i,t}^{E}$	0.30	0.33	0.33	0.36
	(0.15)	(0.20)	(0.14)	(0.15)
$R_{i,t}^{HF}$		2.41		2.94
		(13.91)		(13.97)
No. funds	407	86	259	48
Obs.	1976	267	1072	152

Note: Standard deviations are in brackets. Descriptive statistics for variable $DC_{i,t}^{AEA}$ are computed for pension funds which invest in alternative assets under external and active management.

Source: CEM benchmarking database.

Table 4: Allocation to hedge funds: estimated coefficients and marginal effects (M.E.)

Endogenous variable : $HF_{i,t}$

	(**1**.**a**)		(**1**.**b**)	
	Coeff	M.E	Coeff	M.E
$PRIV_{i,t-1}$	0.418[a] (0.158)	0.066[a] (0.024)	0.398[a] (0.124)	0.059[a] (0.018)
$REAL_{i,t-1}$	-0.101 (0.133)	-0.016 (0.021)	-0.125 (0.080)	-0.018 (0.011)
$FOR_{i,t}$	0.084[b] (0.037)	0.013[b] (0.005)	0.066[a] (0.025)	0.010[a] (0.003)
$RND_{i,t}$	-0.370 (0.626)	-0.058 (0.098)	0.111 (0.539)	0.016 (0.080)
SF_i	2.845[a] (0.583)	0.447[a] (0.091)	3.317[b] (1.346)	0.488[b] (0.198)
$EA_{i,t-1}$	0.067[a] (0.021)	0.010[a] (0.003)	0.112[a] (0.028)	0.016[a] (0.004)
$DIV_{i,t}$	-18.062[a] (4.953)	-2.876[a] (0.787)	-15.415[a] (4.883)	-2.306[a] (0.732)
$SIZE_{i,t-1}$	1.701[a] (0.367)	0.270[a] (0.058)	2.287[c] (1.387)	0.342[c] (0.208)
TYP_i	-0.253 (0.710)	-0.040 (0.111)	-1.232 (1.159)	-0.183 (0.171)
$DC_{i,t}^{AEA}$	-0.582[c] (0..325)	-0.092[c] (0.051)	-0.706[a] (0.222)	-0.105[a] (0.033)
$R_{i,t-1}^{HF}$	0.037 (0.325)	0.005 (0.004)	0.038 (0.029)	0.005 (0.004)
Country-and-time effect	Yes	Yes	Yes	Yes
Mundlak's correction			Yes	Yes
Obs.	1976	1976	1976	1976
Uncensored	267	267	267	267
Log likelihood	-979	-979	-964	-964
χ_2 statistic $[p-value]$	202 [0.00]	202 [0.00]	444 [0.00]	444 [0.00]
Pseudo R^2	0.175	0.175	0.187	0.187
LR test $[p-value]$	573 [0.00]	573 [0.00]	555 [0.00]	555 [0.00]

Note: a, b and c indicate significance respectively at the 1%, 5% and 10% levels. Standard deviations are in brackets. Standard deviations reported in the table correspond to the bootstraped standard deviations.

Table 5: Returns and allocation to hedge funds

Specification	Endogenous variable	$HF_{i,t}$	$hf_{i,t}$	Hausman test $[p-value]$	R^2	Obs.
(**2**.**a**)	$R_{i,t}$	0.1079^c (0.0620)		21.34 [0.26]	0.93	1976
(**2**.**b**)	$R_{i,t}$		1.1377^a (0.3391)	21.33 [0.26]	0.93	1976
(**2**.**c**)	$R'_{i,t}$	0.1176^c (0.0671)		20.95 [0.28]	0.93	1976
(**2**.**d**)	$R'_{i,t}$		1.1894^a (0.3461)	21.15 [0.27]	0.93	1976
(**2**.**e**)	$R^c_{i,t}$	0.1044 (0.0776)		19.86 [0.34]	0.93	1976
(**2**.**f**)	$R^c_{i,t}$		1.0067^a (0.3766)	20.65 [0.29]	0.93	1976

Note: a, b and c indicate significance respectively at the 1%, 5% and 10% levels. Standard deviations are in brackets. Standard deviations reported in the table correspond to the robust standard deviations. All the estimates include ownership and country-and-time effects.