The Return to Pension Funds' Private Equity Investments:

New Evidence on the Private Equity Premium Puzzle

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Abstract

This paper provides new evidence on the private equity premium puzzle suggested by Moskowitz and Vissing-Jørgensen (2002); Even professional investors like pension funds seem to get a poor risk-return tradeoff from investing directly in private equity. We examine whether high risk tolerance, pecuniary and nonpecuniary benefits, overoptimism or political preferences can explain why pension funds despite this invest in private equity. The evidence suggests that mispricing due to overoptimism and subsequent low capital gains can explain the gap in returns to private equity.

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1 Introduction

Asset pricing and investment theory have long studied the risk and return characteristics of public equity. As pointed out by Moskowitz and Vissing-Jørgensen (2002), the private equity market is as important as the public equity market in terms of size and growth. Despite its relative importance, little is known about the risk-return tradeoff in private equity investments.

Two recent strings of literature have estimated the return to private equity investments. One has focused on entrepreneurial investments, while the other has analyzed the return to investments made by private equity funds.

The first string of literature emerged from the question of why people become entrepreneurs. Hamilton (2000) examines the wage differentials in self-employment and paid employment and finds that most entrepreneurs enter and remain in business despite the fact that both the initial level and the growth of earnings are lower. This gap suggests that non-pecuniary benefits are an important motivation for self-employment. Using data on entrepreneurial households, Moskowitz and Vissing-Jørgensen (2002) document that entrepreneurial investments are extremely concentrated and that the returns, despite this poor diversification, are no higher than the returns to public equity.[1] This finding has caused the emergence of the *private equity premium puzzle*: Why do households willingly invest a substantial fraction of their wealth in a single firm without a compensatory return on the investment? Moskowitz and Vissing-Jørgensen suggest, among other things, that non-pecuniary benefits compensate for this gap.

The second string of literature that estimates the return to private equity investments made by private equity funds shows that the ultimate investors historically have accepted a poor risk-

[1] Moskowitz and Vissing-Jørgensen find that households with private equity investments on average have more than 70 percent of their private holdings in a single company.

return tradeoff:[2] Although private equity funds have high relative performance gross of fees (Crochane 2005), the relative performance net of fees appears low (Kaplan and Schoar, 2005; and Phalippou and Gottschalg, 2007).

Collectively, both strings of literature highlight the presence of an apparent private equity premium puzzle: why do investors, given the large public equity premium, allocate substantial capital into this asset class?

This paper exploits unique data on Danish pension funds' investments in private equity to present new evidence on this apparent puzzle. The advantage of this dataset is twofold. First, the Danish Financial Statement Act has, since 1995, obliged pension funds (in Denmark) to disclose the returns on asset classes. This creates a novel opportunity to estimate the *net* return to private equity. Moreover, these data are less exposed to the measurement problems inherent in prior studies of the return to private equity that use data on households or private equity funds. We find a large negative and statistically significant abnormal return to private equity. Our most conservative risk-adjusted estimate shows that private equity has underperformed by 392 basis points *per annum*. This economically and statistically significant underperformance suggests that even pension funds have accepted a poor risk-return tradeoff when investing in private equity.

Second, the novelty of our data allows us to examine potential explanations to this puzzle. The existing literature has listed high risk tolerance, preference for risk, pecuniary or non-pecuniary benefits, over-optimism, misperceived risk, and politically motivated preferences as possible explanations to why investors choose private equity. Whereas these potential expla-

[2] In a recent survey, Denis (2004) summarizes this literature: *Although much progress has been made, our knowledge of the dynamics of private equity returns remains incomplete. Analysis of these phenomena are complicated by the lack of data and the potential selection biases in available datasets. It remains unclear whether private equity returns are different from those of public equity.*

nations have been discussed in the literature, they have not, to our knowledge, been subject to rigorous scrutiny.[3] This paper fills this gap. From pension funds' annual reports, we identify their portfolios of privately held firms. We link these to a unique dataset that comprises *all* privately held firms in Denmark. We thereby obtain data that allow us to test potential explanations to the puzzle.

We begin by stressing that prior research has documented that pension funds are prudent investors (Del Guercio, 1996 and Gompers and Metrick, 2001). Thus, unlike entrepreneurs and individuals, pension funds do not have a high risk tolerance or a preference for skewed returns. We further show that pension fund investments in private equity have not been driven by self-interested managers. We document that the managers and board members of pension funds are rarely appointed to the boards of portfolio companies subsequent to investment. We thereby reject, using a very direct measure, that pension fund investments to any great extent are driven by pecuniary or non-pecuniary benefits accruing to fund managers. We further reject anecdotal evidence suggesting that pension fund investments in private equity are politically motivated. We show that private equity investments by pension funds with politically influenced boards perform no differently than pension funds without board seats occupied by representatives of political organizations. Finally, we disentangle the sources of the poor return to pension funds' private equity investments by showing that their portfolio companies' earnings performance is identical to a matched sample of non-portfolio companies. This points to mispricing due to overoptimism and subsequent low capital gains as the likely explanation for the poor risk-return tradeoff.

Overall, our findings strongly suggest that the private equity premium puzzle also extends

[3]This is primarily due to the difficulty of obtaining firm-level data on private equity as noted by Fenn, Liang and Prowse (1997).

to professional investors like pension funds. Using a novel dataset of private equity investments that allows us to narrow the list of potential explanations, we present evidence suggesting that even pension funds systematically overestimate the probability of success of private equity investments. As pension funds are perceived to be professional investors this finding is likely to extend to entrepreneurs and entrepreneurial households as well. We thereby present new evidence on the private equity premium puzzle.

This paper proceeds as follows: In the next section we survey the literature estimating the return to private equity investments. Section 3 describes the data. Section 4 analyzes the risk-return tradeoff of the pension funds' private equity investments. In Section 5, we scrutinize potential explanations as to why pension funds willingly invest in private equity despite poor returns. Finally, Section 6 offers some concluding remarks.

2 A Survey of the Literature Estimating Return to Private Equity Investments

The literature estimating the return to private equity investments has primarily employed two sources of data. One has used surveys of households and consumer finance, whereas the other has used data on private equity funds from specialized agencies such as Venture Economics. As a result, the first approach estimates the return to investments by entrepreneurs, whereas the second estimates the return to investments by equity funds with an active management role.

Using survey data on U.S. individuals, Hamilton (2000) compares the wage differential between self-employed and paid employees. He finds that the self-employed earn a significantly smaller stream of future earnings. This finding suggests that entrepreneurs are willing to sacrifice substantial earnings in exchange for non-pecuniary benefits, such as the value of 'being your own boss'. In a related study, Moskowitz and Vissing-Jørgensen (2002) estimate the return

on investments in privately held firms by U.S. households. They find that the return to private equity is no higher than the return to public equity and that entrepreneurial investments are extremely concentrated and poorly diversified. This finding has initiated awareness of the private equity premium puzzle: why do households willingly invest substantial amounts in assets with such a poor risk-return trade-off. The private equity premium puzzle suggests that entrepreneurs receive large non-pecuniary benefits from the ownership of privately held firms - otherwise they should invest in the public equity market.

In the literature, entrepreneurial financing has been nearly synonymous with venture capital. The initial studies of venture capital investments have used data on publicly traded funds to estimate returns. Martin and Pretty (1983) provide evidence of a positive excess return to private equity using a small sample of publicly traded venture funds in the U.S. from 1974 to 1979. Gompers and Lerner (1997) study the risk-adjusted performance of a single publicly traded venture capital group and find an excess return of 8 percent per annum. A number of more recent studies have used data on private equity funds provided by specialized agencies such as Venture Economics.

Using data on the performance of individual venture capital investments, a number of studies have attempted to build a private equity index (Peng 2001, Quigley and Woodward 2003, Woodward and Hall 2003) or to estimate the return on individual venture capital projects (Cochrane 2005). Kaplan and Schoar (2005) point out an inherent problem with these studies as the return can be observed only if there is some sort of transaction involving the investment. This creates sample selection bias, which Cochrane (2005) addresses by employing a maximum likelihood procedure to estimate the probability of success.

To circumvent this potential problem, other studies have focused on the cash-flow stream

between private equity funds and their limited partners. Kaplan and Schoar (2005) use a large sample of private equity funds between 1970 and 2001 and find that the return, net of fees, does not exceed the return on public equity. However, they point out that there is substantial cross-sectional variation and some persistence over time in the return on the funds.[4] In a sample almost identical to that used in Kaplan and Schoar (2005), Jones and Rhodes-Kropf (2003) examine the effect of idiosyncratic risk on the pricing of private equity investments. Consistent with Kaplan and Schoar (2005), they find no excess return even though the average fund alpha is positive (but small).

In a recent paper Phalippou and Gottschalg (2007) show that the performance results in Kaplan and Schoar (2005) are significantly biased toward winners. Adjusting for sample selection and writing off the residual value of "living dead" funds, Phalippou and Gottschalg (2007) find significant underperformance for private equity funds. In particular, Phalippou and Gottschalg (2007) show that a significant number of private equity funds are reported as "active" in the Venture Economics data, even though they have not reported any signs of activity in the prior 4 years. Assuming that the residual value of these funds' investments is equal to half of that reported is sufficient to reach the conclusion that private equity funds on average have underperformed the S&P500 index by as much as 3.3 percentage points per annum.

Ljungqvist and Richardson (2003) raise two important methodological concerns that are specific to the evaluation of the return to venture capital funds. Based on the observation that venture capital funds are organized as partnerships, Ljungqvist and Richardson (2003) argue that prior studies do not take into account the timing of the contributions to the funds and

[4]Similarly, Lerner, Schoar and Wongsunwai (2007) report significant heterogeneity in the return to institutional investors' private equity investments. In particular, they find that endowments have outperformed the average institution, whereas banks have underperformed.

the risk profile of the portfolio companies. Ljungqvist and Richardson (2003) have obtained data from a large anonymous institutional investor to shed light on these concerns. They find that it takes 6 years for funds to invest more than 90 percent of committed capital and 8 years before the internal rate of return becomes positive. Taking these measurement problems into account, Ljungqvist and Richardson (2003) find evidence of a positive risk-adjusted return to private equity investments. While this finding contrasts with the results of the prior literature, their study suffers from a relatively modest sample size. The limited sample size is a particular concern if there is persistence in fund performance over time (Kaplan and Schoar, 2005 and Phalippou and Gottschalg 2007) or large heterogeneity in the performance of investor classes (Lerner, Schoar and Wongsunwai, 2007).

A survey of the literature highlights the presence of an apparent private equity premium puzzle: why do investors seemingly accept the poor risk-return tradeoff offered by private equity? This paper seeks to uncover new evidence on this puzzle by scrutinizing the potential explanations. Moreover, as the prior literature (for data reasons) have focused on entrepreneurial households and private equity funds, the current paper provides the first estimate of the return to investments in private equity by investors without an active management role. In addition, this study complements the existing literature by providing an estimate of the return to pension funds' private equity investments using a new data source that is less exposed to the measurement and data problems of prior studies. The use of data from surveys of households could create a negative bias to the estimated return to private equity, since consumption within the firm is likely to be unreported. Similarly, data on private equity funds can suffer from survivorship bias, sample selection problems, and backfilling. To circumvent these potential measurement problems, we make use of a 10-year panel of returns to private equity investments

by the *entire population* of pension funds in Denmark. These returns are reported and externally audited according to government guidelines in the Financial Statement Act, which induces fairly coherent reporting practices across funds and which prevents backfilling. Finally, our data include detailed holdings data which allows us to risk-adjust the private equity returns rather than assuming a market model with a beta equal to one (Moskowitz and Vissing-Jørgensen 2002; Kaplan and Schoar 2005; Phalippou and Gottschalg 2007; Lerner, Schoar, and Wongsunwai 2007; a.o.).

One immediate concern with our results is that they might be sample specific as Lerner, Schoar and Wongsunwai (2007) have documented large heterogeneity in the performance of investor classes. Thus, although we present additional evidence consistent with the existence of a (general) private equity premium puzzle, our analysis is insufficient to conclude that private equity as an asset class is dominated by other asset classes. However, for the current analysis it is sufficient to document the underperformance of the pension funds' private equity investments to scrutinize potential explanations to the apparent puzzle. We proceed by presenting the data in detail.

3 Data on Pension Funds' Investments in Private Equity

The Financial Statements Act of 1995 (the Act) obliges Danish pension funds to specify return on investment by asset classes in their annual reports. The Act specifies 6 categories of assets; real estate, subsidiaries, equity, bonds, loans and other. In addition, it partitions equity into 4 subcategories: publicly and privately held firms, and domestic and foreign firms. For each category (as well as for subcategories), pension funds must report market value (at both the beginning and end of the year) and returns. The Act provides a guideline for the specification of

assets and returns. The yearly return, r_T, should be calculated using a time- and value-weighted formula:

$$r_T = \prod_{t=1}^{T}(1 + r_t) - 1$$

where r_t, the value-weighted return in subperiod t within year T, is given by

$$r_t = \frac{MV_t - MV_{t-1} - CF_{t-1,t}}{MV_{t-1} + W\dot{C}F_{t-1,t}}$$

and MV_t and MV_{t-1} are the market values of the asset class at time t and $t-1$, respectively. $CF_{t-1,t}$ is net cash flow within subperiod t and W is the relative number of days each cash flow has been included in the portfolio. If multiple cash flows occur within the period, each cash flow is weighted with its own relative weight. The length of each time-period is, in principle, determined by flows into and out of the portfolio of the particular asset. However, it is customary among pension funds to use monthly sub-periods.

The reported returns are therefore not biased by new investments within the year and are, thus, comparable across years and among different asset classes. The reported returns, then, are not subject to the criticism of Ljungqvist and Richardson (2003), since they take the timing of the investments and cash flows into account.

Whereas market values for publicly held firms are easily observed, the "market" values of privately held firms are only observable when there is some sort of "exit". If no exit occurs, the Act states that market values for privately held firms should be based on intrinsic value. The Act further specifies that the market values of private equity should be adjusted whenever the changes are "permanent". If pension funds are conservative they might refrain from marking the value of the portfolio investments to market and base the reported market values on book values. Whereas a more conservative accounting practice would produce an upward (downward)

bias on positive (negative) returns, the aggregate effect on the reported return is ambiguous. However, this potential bias will diminish when the evaluation period increases. The observed returns to private equity are therefore a mix of current and stale returns, which necessitates the evaluation of the returns over a longer time period. This is a problem shared with the prior literature.[5]

From exhibits in the pension funds' annual reports, we manually collect the market value of investments in public and private equity and the return on these investments for each year. These data enable us to estimate the return to private equity investments using a panel of all pension funds in Denmark from 1995 to 2004.[6]

In addition, the Act obligates pension funds to provide a list in their annual reports of any investments in firms where either their cash flow or voting stake exceeds 5 percent. This list provides us with information on the investments that have generated the private equity returns. Given that ownership of privately held firms is extremely concentrated, this list is likely to include most private equity investments.[7] We link this data to the *population* of privately held corporations in Denmark. These data are from the firms' filing of annual account statements with the Danish Ministry of Economic and Business Affairs, which all limited liability companies in Denmark are obliged to do by law. These data includes items from income statements and balance sheets as well as the identities of the CEO and board members. These detailed data

[5]Gompers and Lerner (2001) highlight that venture capitalists often refrain from marking portfolio company values to market to present a conservative assessment of the portfolio valuation. Similarly, Woodward (2004, p. 11) emphasizes that the return to venture capital funds are a mix of current and stale returns; *Each quarter, the general partners in the VC fund report the value of each company in which the fund invests to the limited partners. These values are nearly always based on each company's most recent round of financing.*

[6]Throughout this paper we only use domestic investments and refer to them as public and private equity. We have chosen to exclude foreign private equity investments, since these firms are not included in our firm-level dataset. Furthermore, most foreign private equity investments by Danish pension funds took place toward the very end of the sample period.

[7]The within-sample mean (median) investment by individual pension funds measured by share of cash flow is 17.9 (12.5) percent, well above the 5 percent reporting cut-off level.

enable us to investigate the sources of the private equity returns.

Table 1 shows descriptive statistics on the number and the size of pension funds in Denmark from 1995 to 2004. The population of pension funds in Denmark in the sample period has consisted of between 54 and 60 funds.[8]

In 1995 the average pension fund had Danish kroner (DKR) 11.1 billion or Euro (EUR) 1.5 billion in assets, increasing by 2004 to DKR 24.7 or EUR 3.3 billion.[9] Funds with investments in the particular type of equity, had on average DKR 1.6 billion (EUR 214 million) invested in firms quoted on the Copenhagen Stock Exchange and DKR 188 (EUR 25.2) million in privately held firms in 1995. By 2004 this had risen to DKR 1.9 billion (EUR 251 million) and DKR 260 (EUR 34.9) million, respectively. In 2004, the total investment assets of pension funds in Denmark equaled DKR 1,332 (EUR 179) billion - equivalent to 92 percent of GDP. The total market value of investments in public and private equity was DKR 89.8 (EUR 12.1) billion and DKR 11.2 (EUR 1.5) billion, respectively.

Table 1 further shows the number of pension funds with investments in private equity from 1995 to 2004. The number of pension funds with private equity investments has remained fairly constant, but with a slight decrease until 1999 followed by a larger increase until 2004. The pension funds' private equity investments' average share of total domestic equity investments decreased from 15.9 percent in 1995 to 8.7 percent in 2000, but then increased to 26.5 percent in 2004. Table 1 also reports the average number of private equity investments reported in pension funds' annual reports. Throughout this paper we will refer to these as *portfolio investments*. The average number of reported portfolio investments per pension fund with private equity

[8]The number of pension funds increased in 1998 and 1999 due to entry of foreign-owned pension funds and the creation of two temporary public pension funds. It decreases subsequently due to mergers of funds.

[9]The exchange rate between Danish Kroner and Euro is fixed at 7.45 Kroner per Euro.

investments is around 10. However, as the reported investments include both direct investments and indirect investments through funds, the total number of portfolio companies is higher.

Table 2 reports descriptive statistics on the composition of pension funds' private equity portfolios. We identify the private equity funds among the reported portfolio investments and utilize our rich firm-level data to identify each fund's portfolio. When we include fund investments in the pension funds' private equity portfolios, the total number of portfolio companies increases substantially. In 1995, the average pension fund portfolio consisted of 24 companies (12 direct and 12 indirect investments through 1 private equity fund), whereas the median pension fund portfolio included only 13 companies.

Perhaps more interestingly, Table 2 reveals that the bulk of investments by pension funds in Denmark is directly rather than indirectly held through funds.[10] To measure the relative weight on direct versus indirect investments, we calculate the share of the book value of assets and book value of equity that are ultimately owned by pension funds.[11] Direct investment's share of private equity portfolios is surprisingly high throughout the period, although the average share of book value of assets (equity) declined from 94 (90) to 79 (76) percent from 1995 to 2004. Direct investments are even more dominant in the median portfolio, where only a small fraction is allocated into indirect investments through funds.

In summary, Danish pension funds have invested substantial funds in privately held firms. We proceed by evaluating the return on these investments.

[10]Direct investments by pension funds are not specific to Denmark, as recent coverage in the business media reports evidence of significant direct investment by some of the largest institutional investors in Australia, Canada, Germany, the Netherlands, Switzerland, Turkey, United Kingdom, and United States. See Financial Times, November 7, 2005, "*Pension Funds Bypass Private Equity Houses*", FT Mandate, February 2006 Issue, "*Boost for Private Route*", and New York Times "*A New Pension Game*", October 8, 2006. There are few studies of pension funds' direct investments in private equity. The main exception is Nielsen (2006).

[11]Market values on individual investments are not reported in the data. We therefore rely on book values to assess the total value of the portfolio. We calculate the share of book value of assets (equity) by multiplying the pension fund's share of ownership with each portfolio company's book value of assets (equity). We thereby estimate the relative weights on direct versus indirect investments.

4 The Risk-Return Tradeoff

In the previous section, we described the data on pension fund investments in private equity from 1995 to 2004. In this section, we use this data to estimate the abnormal return to the pension funds' private equity investments.

As private equity by nature is not publicly traded, the observed returns are partly based on a subjective assessment of market value. The fact that market values of private equity are unobservable induces a lack of synchronicity between "actual" and reported returns. Moreover, as Gompers and Lerner (2001) point out the use of conservative valuation practices provides a negative bias to the covariance with the market portfolio, which in turn makes private equity investments appear more attractive from a portfolio perspective. Thus, the stale pricing problem makes it difficult to apply the standard techniques to risk-adjust the observed returns.

Due to these obstacles the majority of papers in the prior literature assumes a market model with beta equal to one to assess abnormal performance (Moskowitz and Vissing-Jørgensen 2002; Kaplan and Schoar 2005; Phalippou and Gottschalg 2007; Lerner, Schoar, and Wongsunwai 2007; a.o.). Currently, only three papers attempt to risk-adjust the return on private equity:[12] Woodward (2004) and Jones and Rhodes-Kropf (2004) estimate fund alpha and betas by regressing returns on both contemporaneous and lagged risk factors.[13] However, in a recent paper Dreissen, Lin and Phalippou (2007) show that such an approach might generate large biases in both risk exposure and abnormal performance. To avoid this problem, Dreissen *et al.* (2007)

[12]Other studies have attempted to assess the risk by estimating the correlation between private and public equity returns using data that are less affected by the lack of synchronicity—Moskowitz and Vissing-Jørgensen (2002) find a correlation of 0.7 between the book equity return of public and private equity from 1963 to 1999. Similarly, Phalippou and Zollo (2005b) find that the performance of private equity funds co-varies positively with both business cycles and stock market returns.

[13]As the stale pricing problem is equivalent to the problem of measuring risk for thinly traded stocks, Woodward (2004) and Jones and Rhodes-Korf (2004) apply the Scholes and Williams (1977) technique of including contemporaneous and lagged market returns.

estimate a factor pricing model by applying GMM to a set of price restrictions and find significantly negative alphas for both venture capital and buyout funds.

Obviously, our time series of private equity returns share the statistical problems mentioned above. However, the novelty of our data allow us to analyze the risk of the private equity investments more directly: Unlike the prior literature, our data include detailed information on each pension funds' private equity holdings. Thus, rather than attempting to analyze risk characteristics of private equity as an asset class, we can assess the risk of every single portfolio company and subsequently assess the risk at the portfolio level.

4.1 The Risk of Private Equity Investments

To open the discussion of risk, we provide descriptive statistics on the total risk of private equity as an asset class. We then document the risk-level of individual pension funds' private equity portfolios, a more relevant measure for pension fund decision-making.

Table 3 reports descriptive statistics on the return to public and private equity investments. The descriptive statistics include the total number of pension funds, the average return, the standard deviation, the 10th, 50th and 90th percentiles of the return across pension funds for both public and private equity. Interestingly, the variation in private equity returns is substantially larger than for public equity in all years. In fact, in all years, the standard deviation on yearly private equity returns is at least *twice* as high as for public equity returns. Moreover, when we (in unreported regressions) estimate alpha and the beta measure of risk using the yearly observations in Table 3 we find a beta of 0.47, whereas alpha is negative and insignificant.[14] Economically, the private equity alpha is quite large (-2.2 percent), even though the short sample period makes it difficult to estimate standard errors with precision.

[14]Specifically, we regress the risk premium on private equity on the contemporaneous and lagged risk premium on public equity.

We proceed by analyzing the risk characteristics of individual pension funds' private equity portfolios, which is more directly related to pension fund decision making. We do this in three steps: First we estimate the pension funds' private equity portfolio beta using an industry matching approach. Second, following Daniel, Grinblatt, Titman, and Wermers (1997) we characterize the risk by estimating the average corresponding size and book-to-market quintiles of the private equity portfolios. Third, we conjecture that the private equity portfolios are subject to significant idiosyncratic risk due to a combination of poor diversification and investments in small and newly established firms.

We start the assessment of the risk of private equity by estimating the average beta at the pension fund level. We assume that the risk of each private equity investment can be characterized by the industry beta. To cover all pension funds' private equity investments (i.e. industries) we estimate betas on stocks from 6 Northern European markets (Denmark, Germany, the Netherlands, Norway, Sweden, and the U.K.). In addition, we estimate betas for U.S. stocks (quoted on New York Stock Exchange) as a robustness check. For each individual stock we estimate the beta using return data from the preceding 60 months. The industry beta is then calculated as a value weighted average of the individual betas for firms within the industry. We match the pension funds' private equity investments to the industry using both the two-digit industry level and a best match approach. The best match approach favors the four-digit industry beta, and move to the two-digit industry beta if there are no publicly traded firms within the four- or three-digit groupings. We then average across pension funds using both equal and value weights in each year. Table 4 reports the average private equity beta from 1995 to 2004. In Panel A the reported private equity betas are calculated using equally weighted averages of each pension funds' portfolio beta, whereas Panel B reports betas based on value

weighted averages.

Panel A in Table 4 shows that the average private equity portfolio beta from 1995 to 2004 is 1.012 (1.078) using the average two-digit industry betas from Northern European (U.S.) stocks as benchmark. When we value weight in Panel B the average betas drop to 0.86 and 1.04, respectively. We obtain betas of similar magnitude when we use the best match approach, which favors the four-digit industry beta, and move to the two-digit level if there are no publicly traded firms within the four- and three-digit groupings. In summary, pension funds' private equity investments have average market risk with a beta around 1. Moreover, this finding seems to be robust to both the level of industry matching and geographic scope of the benchmark.

The second step in our risk assessment is to estimate the private equity portfolios' exposure to common risk factors. To do this we apply the approach developed by Daniels *et al.* (1997), which characterizes the risk of an investment by the corresponding quintile number in a Fama-French model. We focus on the size and book-to-market factors. In order to characterize the risk of the individual pension fund portfolios, we identified the two corresponding characteristic quintile numbers for each private equity investment held by a given pension fund in a given year. To do this, we estimate the market value of equity for each portfolio company by scaling book value of assets with the median market-to-book ratio on assets at the 2-digit industry level and subtract book value of debt. The book-to-market ratio is calculated as the book value of equity over the estimated market value of equity. Given the estimates of market value and book-to-market ratio the corresponding characteristic quintile numbers were found using Northern European and U.S. stocks as benchmark, respectively.[15] We then computed the portfolio weighted quintile number

[15]Thus, essentially we sort the Northern European (U.S) stocks in each year and form Fama-French quintile portfolios. We then find the corresponding quintile number for each risk factor for each private equity investment. See Daniel *et al.* (1997) for a thorough explanation of the risk characteristics approach.

for each pension fund for each of the two characteristics. The portfolio characteristics were then averaged across all funds during a year using both equal and value weights. Table 5 reports the outcome of applying the risk characteristics approach by Daniel *et al.* (1997).

Panel A in Table 5 reports the average risk characteristic per year using equal weights. For all pension funds over the period 1995 to 2004, the average size quintile number is 1.4 and 1.6 when we use Northern European and U.S. stocks as the benchmark, respectively.[16] Thus, pension funds have a high private equity portfolio weight on small firms. In addition, the average book-to-market quintile number is 3.2 independent of which benchmark we use. Thus, pension funds have a slight tendency to overweight stocks with a high book-to-market value of equity. A similar conclusion emerges from Panel B, which uses a value weighted average of the individual pension funds' portfolio characteristics. Given the well-documented factor risk-premia (Fama and French, 1993) the expected return on a portfolio with high load on the size factor (small minus big) and a modest load on the book-to-market factor (high minus low) is higher than the return to the market portfolio. Moreover, such a portfolio would have higher risk than the market portfolio.

We close the discussion on risk by conjecturing that the pension funds' private equity portfolios are subject to significant idiosyncratic risk. Table 2 shows that the median number of companies in pension funds' private equity portfolios is fairly small. The median private equity portfolio consists of less than 15 portfolio companies.[17] Thus, the pension funds' private equity portfolios consists of relatively few investments. Moreover, these investments seem to have significant idiosyncratic risk. The literature on asset pricing of both public and private equity

[16]Size quintile 1 (5) consists of small (large) stocks, whereas book-to-market quintile 1 (5) consists of low (high) book-to-market stocks.

[17]Note that we include indirect investments through funds in the total number of portfolio companies. The median portfolio consisted of 10.5 directly and 0 indirectly held portfolio companies in 1995. In 2004, the median was 6.5 and 5 companies for directly and indirectly held portfolio companies, respectively.

highlights that small firms are expected to have higher idiosyncratic risk. In Table 5 we documented that the pension funds indeed invest in small private growth firms. Similarly, young firms are associated with higher idiosyncratic risk due to the high probability of bankruptcy or failure in early stages of the business life cycle. Moskowitz and Vissing-Jørgensen (2002) document that only 35 percent of all firms survive for 10 years. Other studies have provided even *lower* survival rates for newly established firms.[18] Interestingly, portfolio companies are significantly younger than publicly held firms: the average (median) age of the pension funds' portfolio firms is 21 (11) compared to 57 (35) for publicly held firms in Denmark. Thus, the evidence suggests that pension funds' private equity portfolios are subject to significant idiosyncratic risk.

To summarize, using an industry matching approach we find that the pension funds' private equity portfolios have average market risk. When we consider a Fama-French three factor model we find the pension funds' private equity portfolios to be highly exposed to the size risk factor and to a smaller extent exposed to the book-to-market risk factor. Finally, we conjecture that pension funds' portfolios are exposed to significant idiosyncratic risk due to poor diversification and high idiosyncratic risk on the underlying investments. Thus, the evidence seems to suggest that pension fund private equity portfolios are at least as risky as their public equity portfolio.

4.2 The Return to Private Equity Investments

We start the discussion of the return to private equity investments by using the standard approach in the prior literature, which assumes a market model with a beta equal to one. Moreover, as the pension funds also invest in public equity we benchmark the private equity return to the same pension fund's public equity return. We thereby control for pension fund-invariant heterogeneity (e.g. risk attitude) as this will affect both the realized public and private equity

[18] See references in Moskowitz and Vissing-Jørgensen (2002).

returns. We then provide a risk-adjusted estimate of the return to private equity. As the main purpose is to document the underperformance of the pension funds' private equity investments we deliberately use the most conservative risk assessment from our prior analysis to estimate the abnormal return. The attractiveness of this conservative choice is that our estimate then provides a lower bound on the actual abnormal return, since any alternative risk adjustment will enhance the negative abnormal return and strengthen the premise of the paper. Table 6 summarizes the estimated abnormal return to private equity.

A major concern when estimating the return to private equity is whether the sample period is sufficiently long to observe the realization of the return. Private equity investments can be long-term investments in the sense that several years may pass before *any* return is realized.[19] To avoid this potential bias, the analysis includes only pension funds with private equity investments for the period 1995 to 2004.[20]

Table 6 shows that the average annual return to private equity is 5.52 percent when we use equal weights on each pension fund. As evident from Table 1 the pension funds and their investments in private equity vary in terms of size. Thus, when we value weight, using the average reported market value of private equity within the year, the estimated average annual return to private equity increases to 8.33 percent.

More interestingly, Table 6 reports the abnormal return to private equity using three benchmarks: market return (Panel A), pension funds' public equity return (Panel B), and risk-adjusted market return (Panel C).

Panel A assumes a market model with a beta equal to one. As the market index returned

[19] In particular, Table 1 shows that after the turn of the millennium, there was a small increase in the number of pension funds with private equity investments.

[20] In fact the estimated abnormal return to private equity is numerically larger if we include all pension funds.

13.15 percent per year on average, the estimated annual abnormal return to private equity equals -7.63 and -4.82 percent using equal and value weights, respectively. Using a standard F-test to test whether the returns on the market index and private equity are identical, we reject the null hypothesis at the 1-percent level.[21] Thus, the return to private equity has been significantly *lower* than the average return to public equity.

Panel B reports the estimated abnormal return when we use the pension funds' realized return to their public equity investments as benchmark. As pension funds on average realized a slightly higher return to public equity compared to the market index, the abnormal return to private equity decreases. Again, we strongly reject the null hypothesis of comparable means. Thus, Panel B shows that pension funds realized a significantly lower return from their private equity investments. Consequently, this raises the bar for potential explanations to the private equity premium puzzle as the acceptance of the poor risk-return tradeoff cannot be explained by pension fund-invariant heterogeneity.

Finally, Panel C provides a risk-adjusted estimate of the performance of private equity. To provide a conservative estimate of the abnormal return to private equity we risk-adjust using the most conservative assessment of risk from the analysis in the prior section, which is the estimated private equity portfolio betas from Table 4. Thus, the risk of the public equity benchmark in Panel C is assumed to be equivalent to the estimated risk of the private equity portfolio for each individual pension fund. Among the four estimations of beta in Table 4, we use the one with the lowest average risk assessment of the private equity portfolios, which is the value-weighted portfolio beta using Northern European stocks and industry matching on the 2-digit industry

[21] We perform a simple F-test of comparable means. As a robustness check, the Wilcoxon ranksum test as well as a test on the equality of medians have been performed. Both non-parametric tests reject the null at the 1 percent level.

level. Consistently, the average equal-weighted (value-weighted) expected return decreases to 12.14 (12.25) percent per year. However, the risk-adjusted gap in returns between private and public equity is still economically and statistically significant: Using equal weights, pension funds' private equity returns lag as much as 6.62 percentage points per year, whereas with value weights the gap in returns equals 3.92 percentage points per year. These differences are statistically significant at the 1-percent level. Moreover, any alternative risk-adjustment using either betas or the risk characteristics from Table 5 would enhance the negative abnormal return to private equity. Thus, our most conservative estimate shows that pension funds have received a negative abnormal return of 392 basis points per year over 10 years.

An important caveat to the estimated abnormal return on private equity is that the data covers a window of 10 years. Short time series is a problem shared with most of the literature on private equity returns. In our case, the length of the window is determined by the implementation of the mandatory reporting of returns by the government in 1995. Prior to 1995 pension funds reported the return on private and public equity collectively. However, two pension funds have voluntarily reported the return on private equity for a substantially longer time period. Although voluntarily reported returns might be biased toward successful investments, this potential bias will make it harder to establish the performance gap.

Interestingly, these two pension funds are among the largest investors in private equity. The first pension fund, LD (Lønmodtagernes Dyrtidsfond) is by far the largest and most experienced private equity investor with more than 300 investments to date. In the sample period LD accounts for between 13 and 19 percent of the market value of all private equity investments. Moreover, despite Denmark's relative small size, LD is among the 300-largest pension funds in the World (Watson Wyatt, 2006). LD reports the return for both private and public equity from

1980 to 2004. Over this 25-year period LD's average return on private equity lagged as much as 8.8 percentage points *per year* compared to the return on public equity. Similarly, MP Pension (Pensionskassen for Magistre og Psykologer), reports the return over the 15-year period from 1990 to 2004. The return on MP Pension's private equity investments underperformed public equity by 3.6 percentage points per year.

To assess whether these two pension funds are representative, we rank the pension funds based on their average return on equity within the sample period from 1995 to 2004. Interestingly, both LD and MP Pension's average private equity return are above average. LD is ranked as the third best pension fund, whereas MP Pensions ranks 8 out of the total 34 funds with investments in all 10 years. Thus, even among the better performing pension funds the return to private equity lags that of public equity for a substantial time period. Although we cannot provide systematic evidence of the documented underperformance using a longer time series, the two examples highlight the puzzling finding that even professional investors like pension funds seem to get a poor risk-return tradeoff from investing in private equity. In addition, the sheer size of the documented underperformance reduces the likelihood that the results are driven by the length of the sample period.

In summary, we provide strong evidence that the return to private equity investments has been significantly lower than the return to public equity within the 10-year period 1995 to 2004. The difference is large both economically and statistically. Our most conservative risk-adjusted estimate shows that private equity investments have provided a 392 basis points negative abnormal return *per annum*.

5 Potential Explanations for the Poor Risk-Return Trade-off

This section exploits our novel data on pension funds' private equity holdings to test the potential explanations as to why pension funds invests in private equity despite the poor risk-return tradeoff. Moreover, as the pension funds realized a poor return relative to their own public equity investments, any potential explanation as to why pension funds invest in private equity should explain this relative difference as well.

In their seminal paper, Moskowitz and Vissing-Jørgensen (2002) list a number of potential explanations as to why entrepreneurs willingly invest a substantial fraction of their wealth in a single private firm: Entrepreneurs might have a high risk tolerance (i.e. low risk aversion), which will reduce the disutility from poor diversification. Likewise, entrepreneurs might have a preference for skewed returns and therefore accept a lower mean return in exchange for the large potential upside—in other words entrepreneurs are participating in a tournament. Entrepreneurial activity could also be encouraged by the ability to derive pecuniary and non-pecuniary benefits. Pecuniary benefits take the form of consumption through the firm (e.g. perks), whereas non-pecuniary benefits are prestige, reputation, and the value of being your own boss, among others. Finally, Moskowitz and Vissing-Jørgensen point to over-optimism and misperceived risk as explanations for entrepreneurial investments in private equity. In addition to this list, we consider a number of other explanations related to pension funds including relationship building and politically motivated investments.

A. Risk Tolerance and Preference for Skewness

Prior research on institutional investors and their investment preferences has shown that institutions and in particular pension funds tend to be prudent (see Del Guercio 1996, and Gompers

and Metrick 2001, among others). Prudent investors invest in less risky stocks, which is inconsistent with having a high risk tolerance and/or a preference for skewed returns. Thus, unlike entrepreneurs and individuals, pension funds are unlikely to have a high risk tolerance or a preference for skewed returns.

B. Pecuniary and Non-pecuniary Benefits to Pension Fund Managers

Pecuniary and non-pecuniary benefits have been suggested by both Hamilton (2000) and Moskowitz and Vissing-Jørgensen (2002) as explanations for why people become entrepreneurs. Pecuniary benefits usually take the form of consumption through the firm. In essence, these benefits are measurement errors when we evaluate the return to private equity using survey data, since these benefits are unreported. Non-pecuniary benefits, on the other hand, include prestige, reputation and the value of 'being your own boss', which are difficult to quantify.

Although it seems reasonable to argue that pension funds are less likely than individuals to obtain pecuniary or non-pecuniary benefits from their investments in private equity, pension funds are run by managers who might be self-interested. To address this potential explanation, we examine whether pension fund managers get elected to the board, the idea being that as directorship are paid and prestigious, accumulation of board seats capture both pecuniary and non-pecunariy benefits accruing to fund managers.

Our rich data allow us to investigate the relationship between the managers of a pension fund and the appointment of new board members in portfolio companies subsequent to investment. Within the period 1995 to 2004, 39 pension funds reported having at least 1 investment in a private firm where either the cash flow or the voting stake exceeded 5 percent. In the course of this 10-year period, pension funds invested directly in 333 portfolio companies and indirectly in 749 companies through 33 private equity funds. To complete the analysis, we identify new

board members in both portfolio companies and private equity funds. In total, the sample consists of 4355 firm-year observations and, with this dataset, we identify all new board members subsequent to an investment by a pension fund. We then check whether the board members are managers or directors of the investing pension fund using the social security number as identifier.

Table 7 shows that a total of 2514 new board members were appointed in portfolio companies and private equity funds subsequent to an investment by a pension fund. Of these 2514 new board members, only 26 (1 percent) were directors in the pension fund at the time the investment decision was taken. Similarly, 24 (less than 1 percent) of the newly appointed board members were members of the board of the investing pension fund. Table 7 conditions on the timing of the appointment of new board members. Evidently, most appointments to portfolio company boards of managers of the investing pension funds took place while the pension fund was an owner. The lack of a significant accumulation of board seats by the management of pension funds is inconsistent with the idea that these investments are driven by self-interested managers. Thus, using a very direct measure of pecuniary and non-pecuniary benefits, we do not find significant evidence of this as the driving force behind the investments.

Arguably, there are many other more indirect ways to obtain private benefit from portfolio companies than by joining the board. These are difficult to quantify and to measure. We argue that if private benefits are important to the management of pension funds, one of its most likely manifestations would be board representation. We base this belief on the positive motive for board representation - monitoring of the investment. Monitoring of portfolio companies would be a perfect blind for managers to join a board and at the same time to receive private benefits. Still, we find little evidence backing this explanation for pension fund investment in private equity.

C. Over-optimism and Misperceived Risk

In this section, we scrutinize the source of the low private equity return. We make use of our detailed firm-level data to disentangle whether poor performance of the underlying portfolio of privately held firms, missing capital gains, or both are the driving forces behind the low returns.

Our empirical strategy is therefore to test whether underlying performance has been lower in pension fund portfolio companies.[22] We use a simple matching procedure for each portfolio company to form a matched sample of non-portfolio companies. We construct matched samples using both two-digit and three-digit industry codes. The matched sample consists of the 10 (5) firms within the two-digit (three-digit) industry code with the closest proximity measured by firm size (book value of assets) to each portfolio company in each year. This match is repeated for all portfolio companies to form a fairly homogeneous sample of control firms within the period from 1995 to 2004.

Table 8 summarizes the results from regressions of return on assets (defined as EBIT over assets) on a portfolio company dummy. We run 10 yearly cross-section regressions as well as a pooled regression. To provide an overview, Table 8 therefore reports the average coefficient, the average marginal effect, and the number of positive, negative, and significant coefficients for the cross-section models, whereas we report the coefficient and t-statistics for the pooled model. In all regressions we control for industry and size-specific effects by including a dummy for each portfolio company and the corresponding matched sample.[23] In addition, our specification includes firm age and leverage as control variables to ensure that our results are not driven by observable characteristics unrelated to industry and size.

[22]Note that we only focus on portfolio companies. We therefore exclude private equity funds, as their portfolios are included in the sample of portfolio companies. See Section 3.1 for details.

[23]To reduce the influence of outliers we weight the observations with book value of assets. In addition, we have performed median regressions as a robustness check and obtained results of similar order of magnitude.

In the left panel of Table 8, where the matching procedure is based on two-digit industry codes, the coefficient on pension funds' portfolio companies have mixed signs and significance: In 6 (4) out of 10 regressions the coefficient is positive (negative), but only significant at the 5 percent level in 2 (1) cases. Consistently, the average coefficient across the 10 yearly regressions is close to zero. This is confirmed in the pooled model, where the coefficient is positive, but insignificant. These results are robust with respect to the level of industry matching, since we find similar results when we match within three-digit industry codes. On average, pension fund portfolio companies perform no different than a matched sample of similar firms.

A valid concern in the above analysis of the relative performance of portfolio companies to the matched control sample is that the earnings performance of firms with large investments in research and development might be negatively biased. However, as it seems natural to conjecture that pension funds invest in firms with a large demand for external capital, the potential bias is reinforcing our result that pension fund portfolio companies do not perform worse than its peers. Despite this we repeat the analysis on the sub-sample of manufacturing firms where this selection problem should be less severe.[24] Panel B of Table 8 shows that when we restrict the sample to firms operating within manufacturing industries pension funds portfolio companies slightly underperform its peers. On average, pension fund portfolio companies seem to have lower earnings performance than the matched sample of control firms as the coefficient is negative (and significant) in 8 (4) out of the 10 yearly regressions. Interestingly the pooled sample reveals that, on average, pension fund portfolio companies have 1.7 percentage points lower earnings performance than the matched control sample. Surprisingly, our general result, that pension fund portfolio companies perform no different than their peers, do not hold for manufacturing

[24]We classify NACE industry codes lower than 45 as "manufacturing" industries.

firms where the selection bias should be less severe.[25] Although we find lower performance for manufacturing portfolio companies, the order of magnitude cannot explain the poor realized return on private equity: We find a 1.7 percentage point lower return on assets around a sample mean of 6.7 percent, which clearly is insufficient to explain the large gap in returns.

Overall, we find no significant difference in the earnings performance of pension fund portfolio companies. Although, the above exercise is not conclusive, this points toward missing capital gains due to initial over-optimism and misperceived risk as important sources of the disappointing returns. We thereby gain new evidence on the private equity premium puzzle which highlights that over-optimism and misperceived risk are important in explaining the puzzle. As pension funds are perceived to be professional investors our findings indicate that the much cited non-pecuniary benefits do not stand alone in explaining the private equity premium puzzle for entrepreneurs and entrepreneurial households. Over-optimism and misperceived risk are likely to contribute as well.

D. Other Explanations Related to Pensions Funds

In this section, we discuss a number of other explanations as to why pension funds might invest in private equity despite poor returns.

Pension funds manage large portfolios of assets and therefore it might be sensible to hold a small fraction of private equity if the return is sufficiently uncorrelated with the return on other assets. In fact, using U.S. data, Hwang, Quigley and Woodward (2005) show that a mean-variance investor would want to invest a positive fraction in private equity despite the lack of a return premium. This result relies on two important assumptions: i) the mean-variance investor

[25] Obviously, the significantly poorer earnings performance of pension fund portfolio companies in manufacturing industries could still be driven by higher investment into research and development and other cash draining activities by these firms or alternatively by restructuring.

can invest in an index of private equity; and ii) a low correlation between returns to private and public equity.

Both assumptions appear highly contestable. First, in previous sections we show that pension funds have, on average, invested in approximately 15 privately held firms, representing a tiny fraction of the total private equity market. Thus, the assumption that investors can index the private equity market is not backed by the data. Second, using the data from Hwang, Quigley and Woodward (2005), Woodward (2004) shows that the correlation coefficient is significantly negatively biased by the stale pricing problem; as a result, the covariance between private and public equity returns triples.[26] In a similar vein, Moskowitz and Vissing-Jørgensen (2002) and Phalippou and Zollo (2005b) have shown that private equity does not appear to have particularly attractive hedging properties. Finally, it should be noted that even though Hwang, Quigley and Woodward (2005) find a positive portfolio weight on private equity, the inclusion of private equity does not change the efficient portfolio frontier significantly. Thus, even under contestable assumptions which make private equity appear much more attractive from a portfolio perspective, the inclusion of private equity does not yield a higher portfolio return.

We acknowledge that a more thorough and extensive analysis is needed to completely rule out that it can be rational for a mean-variance investor to invest in private equity despite the poor risk-return tradeoff. Our data show that pension funds with private equity investments on average have allocated 2.3 percent of their total portfolio to private equity. Even though this appears to be a tiny fraction of the total portfolio - it corresponds to 17.7 percent of all domestic investments in equity. Thus, pension funds have allocated a significant fraction of their equity investment into private firms.

[26]Woodward (2004) reports that the beta of risk increases from 0.6 to 2.0 when correcting for the stale pricing problem. See section 4 for further details.

In a study of relationship banking in venture capital, Hellmann, Lindsey and Puri (2004) suggest that banks might sacrifice returns in order to obtain future banking income from the portfolio firms. As a case in point, pension funds might diverge from maximizing the return to obtain future pension customers. However, this alternative explanation receives little support since the pension funds' portfolio firms have on average very few employees. The average (median) number of employees in portfolio firms in 2004 is 144 (12). As the average private equity portfolio consists of few firms (see Table 2), the prospects for generating future pension fees are not large enough to cover the large gap in returns.

Other studies have emphasized that pension funds might be committed to the development of the local economy and therefore invest in private equity to stimulate growth and innovation. Phalippou and Zollo (2005b) cite causal evidence of this behavior among pension managers in the U.S. and Europe when they choose to back venture capital funds. Gompers, Schoar and Wongsunwai (2007) find evidence that suggest that public pension funds and public universities in the U.S. face politically motivated pressures or constrains to invest in their local areas with unfavorable effects on performance. In Europe, pension funds have historically been influenced by unions, which suggests that investment decisions might be influenced by political preferences. Political investments to sustain employment in unprofitable industries might have induced pension funds to invest in private equity. Again, it is hard to argue that this political preference should affect private equity investments significantly differently than investments in public firms. Further, as these politically motivated investments tend to attract significant media attention, there seem to be too few examples to explain the large underperformance. Nevertheless, to quantify the influence of political investments, we use another novel feature of our data; our sample of pension funds consists of two types, one managed by labor market parties (unions

and employers' organizations) and one managed by financial intermediaries. As pension funds managed by unions and employers' organizations are more prone to invest politically, we should expect a lower return to private equity for this group, if political motives are important.

Panel A in Table 9 shows the return to private equity for pension funds managed by labor market parties and those managed by financial intermediaries, respectively. On average, pension funds managed by labor market parties realized an annual return of 8.5 percent compared to 7.7 for funds managed by financial intermediaries. The difference of 0.7 percent is highly insignificant.

To further examine the impact of politically motivated investments, we examine election rules in the pension fund bylaws that grant board seats to political organizations (defined as unions and associations of local governments).[27] If political organizations are granted the right to appoint board members, they can indirectly influence pension fund investment policy. In particular, we are interested in board seats granted to unions and associations of local governments as they appoint their leaders and (local) politicians, respectively. Thus, by measuring the number of board seats granted to political organizations, we obtain a measure of the political influence on pension fund investment policy.

Panel B in Table 9 shows the return to private equity for pension funds as a function of the degree of political influence on the boards. We use two measures: in Panel B (I) we divide the pension funds based on whether at least 1 board seat is granted to a political organization, whereas we in Panel B (II) divide them based on whether the majority of board seats are granted to political organizations. Using both measures, we find no significant difference in the return to private equity of politically influenced boards. Thus, politically motivated investments do not

[27]Local governments are actively involved in pension funds managed by labor market parties due to the fact that local governments are employers in a wide range of professions (e.g., education, child care, health care, etc.)

seem to explain why pension funds invest in private equity despite the poor return. Otherwise, we should have found a significantly lower return to politically influenced pension funds' private equity investments.

To conclude, we acknowledge that in the case where all pension funds' investments in private equity are politically motivated, our test would fail to recognize this. Rather, we used the within-sample variation to show that the return to pension funds' private equity investments is unrelated to the organization of the pension fund and to the number of board seats granted to political organizations. We thereby find no evidence suggesting that political preferences can explain why pension funds accept the poor risk-return tradeoff.

6 Conclusion

Prior studies of return to private equity investments have used survey data on entrepreneurial investments or data on investments by private equity funds. Collectively, these studies have found that the return to private equity is no higher than the return to public equity. This paper makes use of a novel dataset of private equity investments by a completely different set of investors—the population of pension funds in Denmark. We argue that these data are less exposed to the measurement problems inherent in prior studies of return to private equity. An additional novel feature of our data is that we have access to the portfolio companies that have generated the returns and the entire population of privately held firms. This allows us to evaluate potential explanations for the realized return.

We show that private equity has dramatically underperformed public equity. Our most conservative risk-adjusted estimate shows that pension funds' private equity return is 3.9 percentage points lower per annum. Thus, pension funds seem to invest in private equity despite a poor

risk-return tradeoff.

We further exploit the fact that our data on pension funds allows us to narrow the list of potential explanations suggested in the literature as to why people invest in private equity despite the poor return. We find that most of the potential explanations discussed in the prior literature cannot explain the large gap in the pension funds' private equity returns. We disentangle the source of this underperformance and show that its driven by missing capital gains presumably due to over-optimism and misperceived risk. As pension funds are perceived to be professional investors the importance of over-optimism and misperceived risk in explaining the private equity premium puzzle is likely to extend to entrepreneurs and entrepreneurial households as well. Overall, these findings provide new evidence on the private equity premium puzzle raised by Moskowitz and Vissing-Jørgensen (2002).

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Table 1. Pension Funds' Investment Assets from 1995 to 2004

This table provides descriptive statistics on the size of pension funds' investment assets. The sample consists of all pension funds in Denmark from 1995 to 2004. We report the number of pension funds, the mean and median market value of all investment assets, as well as domestic investments in public and private equity. In addition, we report the average and median share of total equity investments allocated to private equity and the number of reported portfolio investments (See Section 3.1 for details). All figures are in million DKR. The exchange rate of DKR to EUR is 7.45.

Year	Pension Fund Investment Assets							
	All		Public Equity		Private Equity			
	N	Market value	N	Market value	N	Market value	% total equity allocation	Number of reported portfolio investments
Mean (Median)								
1995	55	11139.1 (2750.6)	49	1594.5 (429.2)	39	188.0 (79.0)	15.9 (13.7)	10.2 (5.0)
1996	55	12561.0 (2991.4)	51	1729.8 (464.0)	38	186.7 (85.6)	14.4 (12.1)	9.9 (4.0)
1997	55	14357.9 (3489.3)	52	2252.6 (569.9)	38	174.3 (74.8)	13.6 (9.5)	9.6 (3.0)
1998	57	15931.9 (4241.2)	56	2828.5 (699.1)	36	211.4 (95.1)	12.6 (7.2)	10.4 (5.5)
1999	60	16455.0 (4232.2)	53	2978.7 (840.9)	36	206.6 (105.0)	10.9 (6.9)	9.9 (7.0)
2000	60	18923.1 (5568.9)	53	3433.8 (959.8)	38	242.8 (72.2)	8.7 (7.5)	9.4 (7.0)
2001	60	20325.1 (6743.2)	54	3292.4 (1019.6)	44	259.8 (60.1)	15.4 (8.2)	8.0 (3.5)
2002	59	20842.1 (6796.0)	54	2594.4 (837.3)	45	253.1 (87.2)	22.5 (11.0)	8.3 (4.0)
2003	58	20905.7 (6940.5)	51	1663.1 (456.1)	43	268.4 (79.0)	28.1 (16.4)	8.0 (5.0)
2004	54	24663.8 (8806.4)	48	1871.2 (565.0)	43	260.3 (95.5)	26.5 (15.4)	9.7 (5.0)

Table 2. Pension Funds' Private Equity Portfolios from 1995 to 2004

This table provides descriptive statistics on the size of pension funds' private equity portfolios. The sample consists of the population of pension funds with private equity investments within the period from 1995 to 2004. We distinguish between direct and indirect investment through private equity funds. We report the number of direct investments, whereas for indirect investments we report the number of funds and number of fund investments. The total number of portfolio companies is the number of direct investments plus the number of fund investments. We measure the relative size of each type by aggregating the share of book value of assets and the share of book value equity that ultimately are owned by pension funds.

Year	Direct Investments			Indirect Investments through Private Equity Funds				Total number of portfolio companies
	Number of investments	% of total assets	% of total equity	Number of funds	Number of fund investments	% of total assets	% of total equity	
Mean (Median)								
1995	12.2 (10.5)	94.3 (100.0)	90.4 (100.0)	1.1 (0.0)	11.8 (0.0)	5.7 (0.0)	9.6 (0.0)	24.0 (13.0)
1996	11.6 (11.0)	93.4 (100.0)	89.0 (100.0)	1.1 (0.0)	14.4 (0.0)	6.6 (0.0)	11.0 (0.0)	26.0 (14.0)
1997	10.8 (8.0)	91.4 (100.0)	86.5 (100.0)	1.1 (0.0)	17.6 (0.0)	8.6 (0.0)	13.5 (0.0)	28.4 (16.0)
1998	10.2 (7.0)	89.1 (99.7)	84.0 (98.4)	1.5 (1.0)	18.3 (0.0)	10.9 (0.0)	16.0 (0.0)	28.5 (16.0)
1999	9.1 (7.0)	85.9 (98.9)	80.5 (92.6)	1.9 (2.0)	21.8 (3.0)	14.1 (0.0)	19.5 (0.1)	30.9 (16.0)
2000	9.1 (7.5)	84.3 (99.0)	77.9 (94.9)	2.3 (2.0)	22.5 (5.0)	15.7 (0.0)	22.1 (0.1)	31.6 (12.5)
2001	8.9 (7.0)	82.2 (99.2)	75.5 (95.6)	2.3 (1.0)	24.4 (9.0)	17.8 (0.8)	24.5 (4.4)	33.3 (15.0)
2002	8.5 (6.5)	80.8 (98.1)	73.8 (91.0)	2.5 (1.5)	28.8 (12.0)	19.2 (1.9)	26.2 (9.0)	37.3 (18.0)
2003	7.1 (5.0)	81.8 (98.7)	76.4 (97.2)	2.3 (1.0)	23.1 (4.0)	18.2 (1.3)	23.6 (2.8)	30.2 (14.0)
2004	8.0 (6.5)	79.2 (97.9)	75.8 (96.2)	1.8 (1.0)	20.0 (5.0)	20.8 (2.1)	24.2 (3.8)	28.0 (12.5)

Table 3. Average Yearly Return on Pension Funds' Equity Investments from 1995 to 2004.
This table summarizes the average yearly return (in percent) of pension fund equity investments from 1995 to 2004. We report the following for both public and private equity investments, respectively: number of pension funds, average return, cross-fund standard deviation, the 10th (P10), 50th (Median), and 90th (P90) percentiles of the distribution of pension fund returns.

Year	Return to Public Equity (%)					Return to Private Equity (%)				
	N	Mean (Std. dev.)	P10	Median	P90	N	Mean (Std. dev.)	P10	Median	P90
1995	49	7.44 (3.30)	3.3	8.1	10.1	39	-0.41 (10.36)	-11.5	-1.0	10.2
1996	51	31.19 (7.13)	26.4	30.7	37.2	38	1.02 (12.05)	-14.1	1.1	12.9
1997	52	33.88 (11.07)	20.0	37.5	45.1	38	16.24 (22.436	0.0	13.1	35.2
1998	56	-3.69 (6.17)	-9.0	-4.1	-1.5	36	12.15 (31.34)	-8.1	4.8	37.2
1999	53	22.71 (7.13)	15.3	22.8	28.7	36	1.78 (14.98)	-9.7	0.6	14.2
2000	53	20.20 (10.05)	4.3	21.5	31.7	38	27.27 (40.66)	-6.9	20.9	86.3
2001	54	-13.94 (5.78)	-20.3	-13.7	-10.7	44	-5.54 (24.85)	-24.9	-3.6	6.9
2002	54	-20.51 (6.37)	-27.2	-20.7	-14.0	45	-6.09 (14.99)	-21.2	-6.8	13.3
2003	51	30.40 (11.16)	22.0	30	36.8	43	-0.59 (19.93)	-20.0	2.1	12.0
2004	48	25.30 (5.63)	20.5	25.4	31.8	43	5.15 (9.15)	-1.6	4.1	16.5

Table 4. Estimation of the Pension Funds' Private Equity Portfolio Beta

This table shows the estimated portfolio beta on pension funds' private equity investments. Panel A uses equal weights on each investment, whereas Panel B reports value-weighted betas. We assume that the beta on each investment can be represented by the value weighted average of the beta on the individual stocks within the industry. We two samples of stocks to estimate industry betas: Northern European stocks (i.e. stocks from Denmark, Germany, the Netherlands, Norway, Sweden and the UK) and U.S. stocks (listed on NYSE). We estimate the beta on individual stocks using monthly returns from the preceding 60 months. We mark the investments to the market on industry level using both the 2-digit industry code and a best match approach. The best match approach matches the investment to the industry beta on the lowest possible industry level (see Section 4.1 for details).

Benchmark:	Northern European stocks			US stocks		
		Industry level			Industry level	
	N	2-digit	Best match	N	2-digit	Best match
Panel A: Equal weighted						
1995	271	0.963	0.921	275	1.052	1.007
1996	300	0.980	0.898	304	1.056	1.026
1997	351	1.004	0.946	355	1.067	1.033
1998	372	1.002	0.955	375	1.074	1.032
1999	388	0.981	0.988	391	1.063	1.029
2000	347	0.979	0.988	350	1.072	1.056
2001	393	1.017	0.974	396	1.084	1.068
2002	414	1.041	1.014	418	1.102	1.088
2003	417	1.048	1.038	420	1.105	1.099
2004	534	1.058	1.048	537	1.103	1.101
Average 1995-2004	3787	1.012	1.004	3821	1.078	1.057
Panel B: Value weighted						
1995	271	0.900	0.907	275	1.077	1.083
1996	300	0.856	0.860	304	1.036	1.039
1997	351	0.848	0.849	355	1.051	1.069
1998	372	0.836	0.846	375	1.034	1.021
1999	388	0.845	0.855	391	1.014	1.006
2000	347	0.859	0.849	350	1.045	1.047
2001	393	0.854	0.854	396	1.013	0.978
2002	414	0.838	0.866	418	1.030	1.036
2003	417	0.854	0.891	420	1.027	1.022
2004	534	0.907	0.918	537	1.075	1.073
Average 1995-2004	3787	0.860	0.869	3821	1.040	1.037

Table 5. Risk Characteristics of Pension Funds' Private Equity Portfolios

This table shows the risk characteristics of Pension Funds' Private Equity Portfolios. Following Daniel et al. (1997) we report the average size and book-to-market quintiles of the private equity portfolios using Northern European and US stocks as benchmarks, respectively. To calculate the average characteristic, the quintile benchmark portfolio number (1 through 5) is identified, each year, for each private equity investment held by a pension fund for both characteristics. Size portfolio 1 consists of small stocks, whereas book-to-market portfolio 1 consists of low book-to-market stocks. The market value of equity of each private equity portfolio company is calculated as the difference between market value of assets and book value of debt. Market value of assets is estimated by multiplying the median market-to-book ratio within the 2-digit industry with the book value of assets. Book to market ratio is book value of equity over the estimated market value of equity. Finally, pension fund average benchmark portfolio numbers are averaged across all funds each year. Panel A assigns equal weight on each pension fund, whereas Panel B use the pension fund's reported market value of private equity investment as weight. The reported average for 1995 to 2004 is the average of the time-series of average characteristics.

Benchmark:	Northern European stocks		US stocks	
	Average risk factor quintile		Average risk factor quintile	
	Size	Book-to-market	Size	Book-to-market
Panel A: Equal weighted				
1995	1.6	3.3	1.4	3.2
1996	1.5	3.4	1.2	3.4
1997	1.6	3.2	1.2	3.2
1998	1.6	3.6	1.3	3.1
1999	1.6	3.2	1.3	3.0
2000	1.6	3.1	1.3	3.3
2001	1.6	3.2	1.3	3.0
2002	1.8	3.2	1.6	3.2
2003	2.1	2.9	1.7	3.2
2004	1.8	3.2	1.3	3.3
Average 1995-2004	1.6	3.2	1.4	3.2
Panel B: Value weighted				
1995	1.7	3.2	1.5	3.2
1996	1.7	3.4	1.3	3.3
1997	1.8	3.0	1.2	3.1
1998	1.8	3.5	1.4	3.1
1999	1.7	3.3	1.4	3.0
2000	1.7	3.2	1.4	3.4
2001	1.7	3.3	1.4	3.2
2002	1.9	3.2	1.8	3.2
2003	2.1	2.8	1.6	3.2
2004	1.8	3.1	1.2	3.2
Average 1995-2004	1.8	3.2	1.4	3.2

Table 6. Return to Private Equity Investments by Pension Funds

This table reports the average annual abnormal return to private equity investments by pension funds in Denmark from 1995 to 2004. Panel A uses the market index as benchmark for the private equity returns by assuming a market model with a beta equal to one. Panel B uses the pension funds' realized return to public equity as benchmark, whereas Panel C reports the risk-adjusted abnormal return. Thus, Panel C reports the average market return with risk equivalent to the portfolio beta on the private equity investments. We only include pension funds with private equity investments for all years within the period. We use a standard mean comparison test to evaluate whether public and private equity provided identical returns. We report the difference and the *p*-value that emerge from the test of comparable means.

Public equity benchmark	Average Annual Return (%)					
	Public equity		Private Equity		Difference	
	N	Mean (std.dev.)	N	Mean (std.dev.)		*P*-value
Panel A: Market return						
Equal weighted	340	13.148 (19.55)	340	5.523 (22.74)	**-7.625*****	[0.000]
Value weighted	340	13.148 (19.55)	340	8.328 (21.32)	**-4.820*****	[0.000]
Panel B: Pension funds' public equity return						
Equal weighted	340	13.350 (20.20)	340	5.523 (22.74)	**-7.827*****	[0.000]
Value weighted	340	13.645 (20.39)	340	8.328 (21.32)	**-5.316*****	[0.001]
Panel C: Risk-adjusted market return						
Equal weighted	340	12.143 (16.45)	340	5.523 (22.74)	**-6.620*****	[0.000]
Value weighted	340	12.250 (16.70)	340	8.328 (21.32)	**-3.922*****	[0.001]

Table 7. Private Benefits to the Management of Pension Funds: Board Seat Accumulation in Portfolio Companies by Management of Pension Funds

This table shows the number of new board members in pension fund portfolio companies subsequent to the investment by a pension fund. We include direct investments, private equity funds and private equity fund portfolios in the sample of portfolio companies. We report the number of new board members and the number of managers and board members of the pension fund. We further partition on whether the new members joined the board while the pension fund was still an owner and after the fund sold out, respectively.

	New board members in portfolio companies	Number of managers and board members of pension funds among new board members of portfolio companies			
		Pension Fund Managers		Pension Fund Board members	
	N	N	%	N	%
All new boards members after investment by a pension fund	2514	26	1.0	24	1.0
- New board members while pension fund is an owner	1774	22	1.2	19	1.1
- New board members after the pension fund sold out	740	4	0.5	5	0.7

Table 8. Return on Assets in Pension Fund Portfolio Companies Relative to a Matched Sample of Companies within the Industry

This table shows the operating performance of pension fund portfolio companies relative to a sample of matched firms. We construct a matched sample of similar sized firms within the industry. On the left side of the table, the matched sample consists of the 10 firms within the 2-digit industry code with the closest proximity in firm size to the portfolio company, whereas on the right side, the matched sample consists of the 5 firms within the 3-digit industry code. We use Return on Assets, defined as EBIT over book value of assets, to measure earnings performance. We report the average coefficient, the number of positive, negative, and significant from the 10 cross-section regressions, whereas we report the coefficient and the *t*-statistics from the pooled model. Panel A makes use of all industries, whereas Panel B focuses on manufacturing industries by excluding firms operating in 2-digit industry codes (NACE) higher than 45. Significance is based on White's robust variance estimator.

Matched control sample:	2-digit industry level			3-digit industry level		
	(1)		(2)	(3)		(4)
Model specification:	Cross-section		Pooled	Cross-section		Pooled
	Average coefficient	Number of positive / negative [significant]	Coefficient (*t*-stat)	Average coefficient	Number of positive / negative [significant]	Coefficient (*t*-stat)
Panel A: All industries						
Portfolio company dummy	-0.0014	6/4 [1/2]	0.0004 (0.29)	0.0049	6/4 [2/0]	0.0042 (2.65)
Control variables	YES		YES	YES		YES
Size and industry effects	YES		YES	YES		YES
Panel B: Manufacturing industries						
Portfolio company dummy	-0.0173	2/8 [0/4]	-0.0172 (-3.87)	-0.0143	3/7 [0/3]	-0.0230 (-5.55)
Control variables	YES		YES	YES		YES
Size and industry effects	YES		YES	YES		YES

Table 9. Politically Motivated Investments and the Return to Private Equity Investments

This table reports the value-weighted average annual return to private equity investments by pension funds with private equity investments in all years from 1995 to 2004. Panel A splits the pension funds into funds managed by labor market parties (unions and employers' organizations) and financial intermediaries, respectively. Panel B splits the pension funds according to the composition of board members: from pension fund by-laws, we identify election rules that grant board seats to political organizations (defined as unions and associations of local governments). In Panel B, I we split the sample of pension funds on whether at least one board seat is granted to a political organization, whereas in Panel B, II we split the sample on whether a majority of the board seats is granted to political organizations. We use a standard mean comparison test to evaluate whether the two groups have identical returns to private equity according to the split. We report the difference and the *p*-value that emerge from the test of comparable means.

	Average Annual Return (%)			Difference	
	N	Mean	(std. dev)		*P*-value
Panel A: Organization of pension funds					
Managed by labor market parties	220	8.520	(19.44)	**0.708**	[0.769]
Managed by financial intermediaries	120	7.722	(26.50)		
Panel B: Board seats granted to political organizations					
(I)					
At least one board seat granted to a political organization	250	8.107	(18.842)	**-1.356**	[0.666]
No board seats granted to political organizations	90	9.463	(31.18)		
(II)					
Majority of board seats granted to political organizations	160	8.512	(18.49)	**-0.499**	[0.833]
Minority of board seats granted to political organizations	180	8.003	(25.64)		