Looking for Alternatives:
Pension Investments around the World, 2008 to 2017

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Abstract

Using hitherto-unexplored data, this paper provides a first look into pension funds' allocations to alternative asset classes around the world. On average, in the ten years following the financial crisis, allocations to private equity and real estate nearly doubled, representing about 20% of assets under management in 2017 for pensions in many of the largest economies. Our sample indicates a $1.8 trillion shift to alternatives between 2008 and 2017. This phenomenon equally affected public and private pension funds, as well as funds of all sizes. This shift does not appear to be a consequence of mechanical factors such as increase in drawn capital or expected returns, but rather reflects a proactive portfolio allocation response to perceived investment opportunities. The extent of the shift to Alts is more pronounced for nations with lower long-term interest rate environment.

Keywords: pension funds, alternative investments

JEL classifications: E02, E44, G23, H55

1. Introduction

Alternative investments have proven to be intensely controversial choices for pension funds, as disputes in geographies as diverse as California, Germany, and Japan have illustrated.[1] On the one hand, alternatives have been at the heart of some of most successful investment programs, such as those of large university endowments (e.g., Lerner, Schoar, and Wang, 2008). Many pensions have adopted alternative-heavy investors such as the Canadian Pension Plan Investment Board and the Yale endowment as role models. At least certain classes of alternatives, such as private equity and venture capital, have historically outperformed the public markets (Kaplan and Schoar, 2005; Harris, Jenkinson, and Kaplan, 2014). And the illiquid nature of these commitments may seem a propitious match with the long time horizons of pension funds.

On the other hand, alternatives have been criticized for their high fee levels (Metrick and Yasuda, 2010). As a result, net-of-fee performance in recent years has lagged, according to analyses by Harris, Jenkinson, and Kaplan (2016); indeed, their tabulations raise the possibility that alternatives during these years may not have provided adequate returns once risk and illiquidity are properly adjusted for. Moreover, there appears to be substantial heterogeneity across the historical returns from alternative investments of different classes of investors (Lerner, Schoar, and Wongsunwai, 2007; Sensoy, Wang, and Weisbach, 2014). Much of the outperformance was historically concentrated in the funds selected by the endowments, which many pensions appear to be unable to access. Critics have consequentially argued (e.g., Appelbaum and Batt, 2014;

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[1] See, for instance, http://www.pionline.com/article/20170619/ONLINE/170619871/calpers-cio-looking-at-possible-drastic-cuts-to-private-equity-citing-transparency, https://www.ipe.com/news/alternatives/bafin-to-curtail-german-pension-funds-alternatives-allocations/10017257.article, and https://www.cas.go.jp/jp/seisaku/koutekisikin_unyourisk/houkoku/h251120.pdf.

Phalippou, 2017) that the movement by pensions towards alternatives represents an investment fad pursued by managers with extensive agency problems (Lakonishok, Shleifer, and Vishny, 1992).

Despite the intense interest in these allocation decisions, the involvement of pensions in alternative investments has not been systematically explored. Using a novel data set, this paper studies these issues by examining the asset allocation decisions made by a global set of nearly 2,000 pension funds over a 10-year period ending in 2017. We focus on pensions' investments in alternative asset classes. We include in this category investments in private equity, private debt, real estate, hedge funds, infrastructure, and natural resources. This last category includes investments in agriculture, energy, metals, timber, and water.

The key findings emerging from our analysis are as follows:

- Fact 1 – Between 2008 and 2017, most of the pension funds around the world had substantially expanded their allocations to alternative asset classes. On average, pension funds in developed markets increased the share of alternatives in their portfolios from 7.2% of assets under management (AUM) in 2008 to 11.8% of AUM in 2017, a 63 percent increase.[2] Pension funds in emerging markets, on average, increased their allocations to alternatives from 0.97% of AUM in 2008 to 6.6% of AUM in 2017.

- Fact 2 – All sizes of pension funds were aggressively expanding into alternative investments between 2008 and 2017. Each size decile (based on 2008 AUM) of pension funds had an economically and statistically significant increase in allocations to alternatives.

- Fact 3 – The ten-year expansion into alternative asset classes encompassed public and private pension funds alike. Given the structural differences between the public and private

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[2] These figures correspond to simple cross-country average.

pension fund sectors, this finding suggests that the driver of this phenomenon is of a universal nature (i.e., a supply factor). In particular, this does not appear to be exclusively a response to the challenges faced by public pension funds in managing their underfunded commitments (Novy-Marx and Rauh, 2011).

- Fact 4 – There is a strong negative relation between the extent of the shift to alternative assets and the long-term rate environment as measured by the natural interest rate in the currency area of the pensions.

- Fact 5 – Alternative asset investments are largely concentrated in private equity and real estate.

These results are striking due to the enormous heterogeneity of pension systems around the world, with a nearly twenty-fold difference in pension assets as a share of GDP across European nations (Scharfstein, 2018). These systems also differ extensively in their governance structures (for an examination of U.S. public pension funds, see Andonov, Hochberg, and Rauh, 2017), degree of underfunding/overfunding (Andonov, Bauer, and Cremers, 2017 and Novy-Marx and Rauh, 2009, again with a U.S. focus), and many other dimensions. Yet when it comes to the shift in asset allocations towards alternatives, the overwhelming impression is one of homogeneity, despite the many other differences.

We also find that these results cannot be explained by the appreciation of existing alternative investments, as the returns of these assets would have needed to substantially exceed any historical return figures. Further analysis indicates that currency areas with lower interest rate environments experienced the largest increases in allocations to alternatives.

These changes are important for several reasons. One of these is the sheer magnitude of the capital being shifted. In our sample, we observe a $1.8 trillion shift to alternatives between 2008

and 2017. If the shifts in the funds in our sample are representative of the pension industry more broadly, the actual magnitude of the shift to higher-cost investments over the decade following the financial crisis is likely to be even larger. Moreover, these numbers correspond to the value of the deployed capital, and substantial commitments to alternatives remain uncalled as of the end of 2017. This points out to a substantial exposure of a wider range of households to private asset class, and a mounting pressure on its future performance.

Second, the consequences of alternative investment funds' transactions for the economy remain poorly understood. In general, the varying levels of pension savings appear to be associated with widespread differences in banking, corporate, and household financial characteristics (Niggemann and Rocholl, 2010; Scharfstein, 2018), though disentangling the arrow of causality can be challenging. More specially, Kortum and Lerner (2008) and Mollica and Zingales (2007) have argued that the pension funds' shift into one form of alternative investments—venture capital—impacted the rate of entrepreneurship and innovation within local economies. While an exploration of the downstream consequences of these shifts is beyond the scope of this paper, it is an important topic for future research.

These changes are also important i understand, given the controversy surrounding the financial sector's growing share of economic activity. The financial sector's share of U.S. gross domestic product rose from less than four percent in 1950 to eight percent in 2010, with an acceleration after 1980, as documented by Philippon (2015). To the extent that the rise of alternatives represents a shift to high-fee intermediaries away from lower-cost public equity and debt managers, this allocation shift may contribute materially to the growth of the financial sector. Given the numerous arguments that the financialization of the economy may have problematic consequences (e.g., Zingales, 2015), these patterns deserve attention.

The rest of this paper is structured as follows: Section 2 describes the data used in the analysis, Section 3 presents the results and explores alternative explanations, and the final section concludes the paper.

2. Data

The main dataset used in the analysis was compiled by Preqin and has been hitherto unused in academic research. The data cover the period between 2008 and 2017 and provides annual allocations to different alternative asset classes for individual pension funds. We observe AUM, in addition to realized allocations to private equity, private debt, real estate, hedge funds, infrastructure, and natural resources. These allocations are aggregated under the "Alts" category and include fund and direct investments, i.e., co-investments with traditional funds and solo investments.[3] We restrict the sample to funds that had non-zero allocations to alternatives at any point over our sample period. In addition, for the analysis, we restrict the sample to funds with at least five years of data (our larger sample), but will report separately the figures for funds with complete coverage for 2008-2017. Our final sample has 1,960 pension funds (1,025 funds with the full ten years of data).

Table 1 presents a snapshot of the data in 2017. Individual countries are included for presentation on the condition that they have more than one pension fund reported. The data covers 23 developed economies and 16 emerging markets, with a wide coverage of different geographical regions.[4] Overall, in 2017, the data captures US$19.7 trillion in AUM and US$2.8 trillion of

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[3] For more details on these type of investments, see Fang, Ivashina, and Lerner (2015).
[4] We use the MSCI market classification (https://www.msci.com/market-classification) to identify countries as belonging to either developed or emerging economies.

allocations to alternative asset classes. Allocations to Alts, on aggregate, are smaller for emerging economies, standing at 7.4% of AUM, as compared to 15.3% for developed markets.

The data also identify public and private pension funds. For developed markets, 21 countries have data for both public and private pension systems. Most of the countries in emerging markets only have data for public pensions due both to the youth of the private pension systems in those countries and limited reporting. In total, the data present a balanced view of the public and private pension sectors, with about 60% of the presented aggregate AUM belonging to public pensions and 40% to private pensions.

[TABLE 1]

Preqin collects data from multiple sources and does not appear to follow any explicit criteria or cut-off point in their coverage. It is likely, however, that the Preqin coverage is focused on the large funds in any given country. In Table 2, we compare the total AUM of pension funds available in Preqin to AUM figures for the entire pension fund industry for the year ended December 31, 2016, as reported by the Organization for Economic Co-operation and Development (OECD).[5] For each country, OECD data are compiled from regulatory agencies (e.g. the Department of Labor and the Federal Reserve Board for U.S. data, and the Office of National Statistics for British data), and are likely to be comprehensive. For example, the OECD reports $2.404 trillion total AUM in the Canadian pension system. Preqin has data available on select Canadian pension funds (public and private) with collective AUM of $1.402 trillion, or 58.3% of the total as reported by the OECD. Overall, our sample covers a substantial fraction of the OECD pension assets. Moreover, while the

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[5] OECD data were downloaded on August 8, 2018 from https://data.oecd.org/pension/private-pension-assets.htm#indicator-chart. 2016 was the most recent sata available at that time. Note that "private pensions" in the OECD files refers to private arrangements (funded and book reserves) and funded public arrangements.

OECD data aim to have a universal coverage, it also appears to have some gaps, as in a few cases, total AUM in our sample exceeds the OECD figure.

[TABLE 2]

A limitation of Preqin data is that it only contains data on allocations to alternative asset classes, without providing overall composition of AUM. To understand which asset classes contract over our sample period as the commitments to alternatives grow, we look (for the U.S. only) at information from the Pension & Investments 1000 (P&I), which tracks the largest 1000 U.S. pension funds as measured by their AUM. The data available to us cover the period between 2006 and 2015. P&I data are collected using non-anonymized surveys. Although the P&I data contain some information on both defined benefit and defined contribution plans, allocations to alternative asset classes are primarily available for defined benefit plans. We consequently limit the P&I analysis to funds with at least 50% of their 2007 AUM in defined benefit plans. We require that the data have non-zero values for allocations to cash and cash equivalents, public equity, and fixed income (i.e., "vanilla" asset classes).

Another advantage of the P&I data is that it provides a split of the assets in defined benefit accounts and defined contribution accounts, whereas in Preqin data we only observe whether the pension fund is public or private.

In addition to the portfolio data, we use several aggregate sources of information on pension fund size and growth, as well as the Alts market. Performance data for alternatives is from Preqin's standard subscription service (which is different from the Preqin Alts portfolio data).

3. Results

A. *2008-2017 change in allocations to alternatives*

Table 1 examines evolution of allocations to alternatives between 2008 and 2017. Realized allocations to Alts are scaled by the contemporaneous AUM. This approach is reasonable because pension funds target a specific percentage allocation of AUM to various asset classes (in future work, we will look at the relationship between the pension funds' target allocations and their actual holdings, which we focus on here). In Panels A and C, we look at the funds with ten years of data (a balanced panel). In Panels B and D, we look at all funds with at least five years of data available over the sample period. In Panels A and B, observations of individual funds are equally weighted within a country.

The first fact that emerges from the analysis is a large international rise in allocations to alternative asset classes. Panel A indicates that, between 2008 and 2017, in 11 (or 35%) of the countries covered in the sample, pensions more than doubled their allocations to Alts.[6] Nineteen (or 61%) of the countries saw pensions increase their target allocations to Alts by over 50 percent. In most of the countries with smaller changes in target allocations, pensions already had close to 10% of their portfolios in private asset classes in 2008. On average, pension funds in developed markets increased their allocations to Alts from 7.22% of AUM in 2008 to 11.76% of AUM in 2017, a 63 percent increase. Pension funds in emerging markets, on average, increased their allocations to alternatives from 0.97% of AUM in 2008 to 6.64% of AUM in 2017 (all figures are statistically different from zero, and all differences are statistically different from zero at the 1% level). The top ten countries with the largest allocations to Alts as of 2017 are the U.S. (19.6% of

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[6] Throughout we omit from calculation countries grouped under "Other," that is, countries with only one reported pension fund.

AUM), Canada (17.4%), Switzerland (14.4%), U.K. (4.9%), Italy (21.4%), Germany (9.1%), Finland (3.5%), Sweden (6.9%), South Korea (15.9%), and Brazil (13.8%). All of these countries had experienced a sizable increase in allocations to Alts over the sample period.

For funds with at least five years of data, the simple within-country change in allocations to Alts between 2008 and 2017 is affected by the changing composition of the sample. To overcome this issue, we also compute an annual change to make it comparable across funds. For example, the average Alts allocation in 2008 is about 4.5% of AUM; thus, an annual increase of 0.5% of AUM would lead the fund to more than double its share of Alts by 2017. The average annual change for this sample is 0.62% of AUM, different from zero at the one percent statistical level; the median is 0.46%.

[TABLE 3]

The increase in allocations to Alts is relatively gradual over the sample period. There are several reasons why building a portfolio of alternatives is a slow process. Perhaps the most evident reason is that this is an asset class where funds are only raised intermittently, so commitments can be achieved only over spaced periods of time through a bilateral bargaining process. This growth could be further slowed down if the pension fund is aiming to access the best-performing funds. Similarly, direct investments in alternatives require sourcing and substantial due diligence, a process that takes considerable time. In a 2017 interview, the Co-Chief Investment Officer of PFA, the largest private pension fund in Denmark which was seeking to substantially expand its portfolio share of alternatives, stated:

> The nature of these investments is quite different from the listed market. In the listed market when we need exposure we can tap it, but when it comes to this kind of investments we need to wait for the right opportunity, we cannot just go and tell out there in the market, "I want infrastructure tomorrow," it doesn't work that way. We need to wait for tender opportunities

coming for a highway or a windmill park, for instance. So, one builds up his exposure gradually over time, and it takes quite a bit of time.[7]

Moreover, a quick allocation into alternatives through funds is not desirable, as it could lead to substantial short-term write downs due to the so-called "J-curve," which describes the J-like shape of gross cash flows over time to a limited partner from a typical fund investment. Finally, even after a capital commitment to a fund, the funds are deployed gradually over a period of (typically) five years.

The value-weighted figures reported in Panels C and D of Table 3 tell a similar story. They also highlight that larger funds already had significant allocations to alternatives in 2008. While they still experienced a rise in their target allocations to Alts, the change was not as large as that of the smaller funds that had practically no allocations to alternatives before the financial crisis.

This point is best summarized in Table 4. In this table, we sort pension funds in our sample in size deciles (based on 2008 AUM). Each size decile shows an economically and statistically significant increase in allocations to alternative asset classes. The percentage point increase for smaller funds is the largest. The two smallest deciles increase their AUM share of Alts by 6.5 and 8.9 percentage points, respectively. Conditional on the decision to invest in alternatives in a pro-active way, this should not be surprising. First, smaller pension funds start from a lower base; in 2008, the average allocation of the smallest pension funds was less than 0.1% of AUM, compared to nearly 10% of AUM for the funds in the top size decile. Perhaps more importantly, an allocation to alternatives requires a certain minimum nominal size. Moreover, if a pension fund is looking to diversify its fund commitments across different managers and vintage years or to gain access to

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[7] For more details see Ivashina, Gabrieli, and Lenhardt (2017).

co-investments, it would need to commit even larger amounts of capital, which can be sizable in comparison to a small pension's AUM. In summary, while historically only the largest pension funds were investing in private equity and other alternative classes, this practice has diffused over the last ten years, with all sizes of pension funds aggressively expanding into Alts between 2008 and 2017.

[TABLE 4]

In Table 5, we split the sample between public and private funds using an indicator provided in Preqin. The insight that emerges from this analysis is there is not a clear difference in the shift to Alts between public and private funds. For example, using information in Panel A for equally-weighted (within country) cross-fund averages, we can see that average change in allocations to Alts between 2008 and 2017 was 5.15% of AUM for public funds and 6.26% of AUM for private funds. The difference is not statistically different (*p*-value of 0.64). Similarly, a simple cross-fund average for this sample yields an average change of 9.51% of AUM for public funds and 8.33% of AUM for private funds; again, not a significant statistical difference (*p*-value of 0.14). Even for the U.S., where several of the public pensions are known to be severely underfunded, the shifts in allocations to Alts for public and private pensions closely track each other at 12.27% and 11.96% of AUM, respectively (the *p*-value of the difference of 0.78).

What is remarkable about this finding is that there are fundamental differences in potential pressures faced by these institutions. Public pensions tend to have a significant defined benefit component, while private pensions are primarily defined contribution. Many of the public pension funds are underfunded as a result of high promised benefits and adverse demographic trends. Thus, a shift to alternatives may be perceived to be a potential solution to the underfunding problem. Defined contribution systems, by design, cannot be underfunded. However, even corporate clients

can relatively easily switch pension managers, which may create pressures to reach for potentially higher-yielding Alts as well, particularly in a low-return environment.

[TABLE 5]

B. Interpretation of the rise in allocations to alternatives

We attribute an increase in reported allocations to alternatives to a proactive shift in the investment strategies of pension funds. Anecdotal accounts of pension funds' aggressive expansion of their allocations to alternative asset classes in the period following the Global Financial Crisis are abundant. Ivashina, Gabrieli, and Lenhardt's (2017) account of strategic changes at PFA and Rhodes-Kropf et al.'s (2014) account of Texas Teaches Retirement System's strategic changes both present detailed discussions of the motives and specific steps undertaken by these funds. Part of the insight of this paper is to document that these accounts are manifestations of a broader, worldwide phenomenon. Thus, we want to be clear that facts documented here cannot be explained by construction of the variables.

Our central metric in the analysis is Alts allocation in percent of AUM. That is, for a fund i in year t:

$$\frac{Total\ NAV_{it}^{Alts}}{AUM_{it}} = \frac{\sum_J Drawn\ capital_{ijt} * (1 + E_t(R_j))}{AUM_{it}} \qquad (1)$$

For fund investments, net asset value (NAV) is determined by the general partner managing the fund (j). According to Jenkinson et al. (2016), this measure represents a relatively accurate estimate of the future cash flows from the fund investment. It is important to note that NAV is calculated based only on the drawn capital, and not on committed-but-undrawn capital. Committed capital is the maximum aggregate gross amount that can be called by the fund over the span of its life.

However, capital is typically only called when alternative managers find attractive investment opportunities.

From (1), we can see that besides a proactive shift in allocations to Alts, there are three mechanical possibilities for why the share of Alts in the portfolio could have gone up. It could be because: (i) the calls of undrawn capital commitments (and not the capital commitments themselves) increased, (ii) the realized return from Alts—as compared to other asset classes—had gone up, and/or (iii) the NAV of alternatives did not change that much in absolute terms but the overall AUM had shrunk. Each of these possibilities is an unlikely explanation for the trends seen here.

First, over our sample period, the "dry powder"—the undrawn amount of the capital committed to alternative investments—had gone up dramatically. As Bain & Company (2018) points out, global dry powder has been on the rise since 2012 and hit a record high of $1.7 trillion in December 2017. Thus, an acceleration in drawdowns does not seem to have occurred.

Similarly, the hypothesis that this trend is driven by the superior returns of the Alts does not seem to be borne out. As mentioned in Section 2, in the Preqin data we only observe allocations to alternative asset classes. But the P&I data allows us to see the composition of U.S. defined benefit plans' AUM. The results reported in Table 6, Panel A indicate that public equity is the largest asset class in the pensions' portfolios. In 2008, over 40% of U.S. pension funds' AUM was allocated to domestic public equity. An additional 20% was allocated to international public equity. As is well known, the U.S. stock market has had a spectacular performance since 2008. Between the end of 2008 and the end of 2017, the annualized total rate of return on the S&P 500 was 15.3%. Over the same period, the Russell 2000 and MSCI World Index had similar performance, with 14.9% and 12. 6% annualized returns respectively.

A back-of-the-envelope calculation can show that that the outperformance of Alts is not a credible explanation for the rise in percentage allocations to Alts. We can compute the return on Alts that would be necessary for their share of U.S. pension holdings to increase from 7.4% to 19.6% without any change in allocation policy. To simplify assumptions, we fix AUM at their 2008 levels. We assume an annual return on cash and equivalents of 0% and a 2% annual return for fixed income (roughly the return on the long-term U.S. Treasury bonds over this period). This setup implies that the annual return on Alts would have had to be 26% for percentage allocations to Alts to grow from 7.4% to 19.6%. (In a simple fund model with a 2% fee and a 20% carry charged by the fund manager, a net return of 26% translates to gross-of-fees annual return of roughly 32%). Note that this return is across all alternative asset classes, some of which have a fixed income-like profile.

The NAVs of Alts reported by pension funds aggregate a range of vintages, and not in an equally-weighted way. One would need to have far more details to be able to compute a mean realized return for any given year. Ultimately, however, the question is whether there are any performance indicators that could lead us to believe that expecting a net-of-fees return on private asset classes in excess of 10 percentage points (per year) over the S&P 500 would be justifiable.

We already mentioned the comparisons of private equity to the public market made by Harris, Jenkinson, and Kaplan (2016), which use data from Burgiss to point out that there was little difference in performance over the past decade across recent vintage years. According to Preqin, the average public market equivalent (PME) computed using Kaplan and Schoar's (2005) methodology for vintages 2007 to 2011 (which would presumably make up the bulk of the portfolio in 2017) was 1.03 (with a standard deviation of 0.06), or essentially identical to the

public market benchmark.[8] For real estate, which has a heavy representation in the pensions' portfolios, the PME was 0.85 (std. dev. 0.17). For all private asset classes, the PME for the same vintages was 0.94 (std. dev. 0.04). In sum, there is little evidence of outperformance.

Finally, the last mechanical possibility is that AUM in general are contracting and pensions are exiting other asset classes before Alts. Conditional on AUM shrinking, this would be a reasonable explanation, as Alts are illiquid and can be only exited on a relatively inefficient secondary market, often at a steep discount. Throughout our sample period, however, the pensions' AUM are increasing. For funds with ten years of data, global pension AUM are increasing at 5.8% annual asset growth over the sample period, slightly faster than the 2000-2008 growth rate of 5.0% implied in the OECD data.

[TABLE 6]

Table 6 also illustrates that increases in pensions' allocations to Alts in the U.S. came at the expense of allocations to domestic public equity. Anecdotally, the shift toward alternatives has been driven by the persistent low-yield environment in fixed income. This does not mean that one should expect fixed income allocations to necessarily contract. The allocations toward different asset classes are results of portfolio optimizations where correlations among returns are taken into consideration. If investment-grade fixed income allocations are used to diversify the risk of equity (which they have been, historically), pensions may be reluctant to cut their fixed income positions.

As discussed in the previous section, the aggressive shift to Alts following the 2008 Global Financial Crisis can be seen (i) for funds around the world in both developed and emerging

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[8] Preqin uses the Kaplan and Schoar PME with the S&P 500 as the public market benchmark. Thus, a PME equal to 1 means that the investment performed on net as would a same-sized investment in the S&P 500.

markets, (ii) funds of all sizes, and (iii) both public and private funds. In unreported analyses, we see this pattern across nations of all legal origins, though the effects are somewhat stronger for pensions in common law nations. This evidence implies that the factors explaining the worldwide shift to alternatives are likely to be of an aggregate nature. One possibility is that there was a fundamental shift in absolute attractiveness of the Alts (i.e., a rise in investment opportunities), but this is at odds with both the modest returns relative to the public market noted above, as well as current market conditions. Many observers have highlighted the very high valuations in this segment and the reluctance of the private equity industry to deploy the funds that they have raised.[9]

Anecdotally, prolonged period of low yield environment had often been pointed as a key adverse pressure on pension funds.[10] For example, the European Insurance and Occupational Pension Authority (EIOPA) *Financial Stability Report* for the first half-year of 2012 stated, "[R]ecent months have again seen the 10Y [Euro] benchmark rate decline to levels well below 2%. Clearly, long-term rates are of critical importance to life insurers and pension funds, as these institutions typically have long-run obligations to policyholders and pensioners that become more expensive in today's terms when rates are low." EIOPA's *Financial Stability Report* for the first half-year of 2016 similarly reads, "The ongoing low interest rate environment continues to generate challenges to the European occupational pension fund sector. […] In the course of 2015, lower interest rates had a further negative effect on cover ratios for most of the countries of the sample."

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[9] See, for instance, Bain & Company, 2018. Also, S&P's *Leveraged Commentary & Data (LCD) 2018:Q2 Leveraged Buyout Review* indicates that, every year since 2014, EBITDA transaction multiples had been above their historical peak, which was in 2007, right before the Great Financial Crisis unraveled. Overall, even including the last peak, the average transaction multiple for buyouts from 1994 to 2007 was 7.44x, compared to 9.05x for our sample period.

[10] Although this is outside of the scope of our paper, insurance companies face a similar pressure.

In what follows, we look at the relationship between the low-rate environment and the growth in allocations to Alts. Because of the slow-moving and opportunistic nature of the allocations to alternative asset classes pointed out above, short-term movements in monetary policy are unlikely to have an effect on allocations to Alts. Instead, we explore the variation in the cross-section. We want to measure where the interest rates are headed, and we need a comparable measure for a set of counties. As Williams (2003) points out, in the long-run, nominal interest rates should be equal to the "natural" or equilibrium real rate of interest plus an adjustment for expected long-run inflation. Thus, our key dependent variables are the natural rate of the economy—the real short-term interest rate that would prevail absent transitory disturbances—estimated for the U.S., Canada, the Euro Area, and the U.K. by Holston, Laubach, and Williams (2017). We also use their code to estimate the natural rate for Japan (although inclusion of Japan does not affect our estimates in a significant way). As additional controls, we include GDP growth and inflation over the same period as the natural rate is calculated. Table 7 reports the results for a five-year lagged average.

There appears to be a negative relationship between the interest rate environment and allocation to Alts, albeit these estimates cannot be interpreted as causal. A 50 bps change in the five-year average natural rate (slightly below the sample standard deviation) is associated with a 0.25 percentage point increase in the average annual change in the Alts share.

[TABLE 7]

4. Final remarks

As highlighted in the introduction, we examine the investment decisions between 2008 and 2017 of over two thousand pension funds around the world. We show that they substantially expanded their allocations to alternative asset classes, increasing those allocations as a share of AUM by nearly five percentage points. In contrast to the heterogeneity in other aspects of pension

fund management, this pattern was seen across all geographical regions, sizes, and types of pension funds, with much of the capital flowing to private equity and real estate funds.

Beyond the issues raised in the introduction, these patterns pose two important questions. The most relevant question has to do with what these shifts in portfolio allocations imply for the returns of pension funds. As noted earlier, substantial questions surround the expected future returns for alternatives. Moreover, one enduring pattern in these markets is the sensitivity of returns to inflows (e.g., Kaplan and Stein, 1993; Gompers and Lerner, 2000; Kaplan and Schoar, 2005). In many classes of alternatives, vintages where there is a considerable amount of commitments often yield poor returns, presumably in large part due to the bidding up of valuations and the relaxation of underwriting standards. Thus, the consequences that the dramatic move by pensions into Alts between 2008 and 2017 documented in this paper will have on future returns of pensions, and their potential impact on household savings, are an important issue.

The second concern relates to the possible consequences of these allocation shifts in a downturn. The financial crisis of 2008-09 posed liquidity challenges for a number of investors such as the Harvard endowment, which undertook "fire sales" of many of its alternative investments.[11] The typical pension fund's allocations to alternatives have not approached the levels seen in the most aggressive of endowments, foundations, and family offices. Nonetheless, it is natural to worry about how the illiquidity of these positions might have deleterious impacts during a sharp correction.

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[11] See, for instance, https://www.nytimes.com/2009/10/06/business/06sorkin.html.

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Table 1. Sample Coverage – AUM and Allocations to Alternative Asset Classes in 2017 ($ Billions)

Country	Region	Full sample		Public funds		Private funds	
		AUM	Alts	AUM	Alts	AUM	Alts
US	Americas	7,632.04	1,395.58	4,266.04	958.43	3,366.00	437.15
Canada	Americas	1,522.51	358.25	1,313.72	334.13	208.79	24.11
Japan	Asia& Pacific	386.26	9.54	267.65	1.93	118.61	7.61
Australia	Asia& Pacific	34.47	2.85	21.86	1.76	12.61	1.08
Hong Kong	Asia& Pacific	8.29	0.73	8.29	0.73	--	--
EMU	Europe (EMU)	4,169.83	373.37	2,819.15	233.11	1,350.68	140.25
Netherlands	Europe (EMU)	3,299.79	253.49	2,376.16	154.16	923.63	99.32
Germany	Europe (EMU)	435.20	67.51	163.64	42.23	271.56	25.28
France	Europe (EMU)	147.40	9.72	112.85	9.08	34.56	0.64
Finland	Europe (EMU)	96.10	18.12	85.24	15.99	10.86	2.13
Italy	Europe (EMU)	85.35	18.27	45.41	10.06	39.94	8.21
Portugal	Europe (EMU)	33.88	1.00	20.26	0.08	13.63	0.92
Spain	Europe (EMU)	21.36	1.91	4.37	0.26	16.99	1.66
Belgium	Europe (EMU)	20.79	1.11	2.98	0.44	17.81	0.67
Austria	Europe (EMU)	18.99	1.57	8.24	0.80	10.75	0.77
Ireland	Europe (EMU)	10.97	0.67	--	--	10.97	0.67
UK	Europe	1,742.24	234.08	457.61	68.94	1,284.63	165.14
Switzerland	Europe	880.71	189.48	327.99	61.84	552.71	127.64
Denmark	Europe	500.70	34.45	410.62	22.89	90.08	11.56
Sweden	Europe	430.99	61.81	239.34	34.80	191.66	27.01
Iceland	Europe	33.08	2.66	30.26	2.35	2.82	0.31
Norway	Europe	27.40	3.70	17.29	2.73	10.11	0.97
Liechtenstein	Europe	5.04	0.28	4.51	0.24	0.54	0.04
Israel	Middle East & Africa	139.44	7.24	100.44	6.02	39.00	1.22
	Total developed markets:	17,513.00	2,674.02	10,284.76	1,729.91	7,228.24	944.11
Brazil	Americas	161.83	17.38	26.14	6.01	135.68	11.37
Mexico	Americas	145.50	16.14	8.72	1.09	136.78	15.05
Colombia	Americas	89.00	7.18	--	--	89.00	7.18
Chile	Americas	80.80	1.72	--	--	80.80	1.72
Peru	Americas	58.00	8.83	5.50	0.99	52.50	7.84
Other	Americas	10.70	0.20	10.28	0.20	0.43	-
South Korea	Asia& Pacific	674.96	65.34	631.25	64.58	43.71	0.76
Taiwan	Asia& Pacific	342.70	2.04	342.70	2.04	--	--
Malaysia	Asia& Pacific	222.02	11.19	222.02	11.19	--	--
Thailand	Asia& Pacific	71.17	4.36	71.17	4.36	--	--
Philippines	Asia& Pacific	29.81	0.47	29.81	0.47	--	--
Indonesia	Asia& Pacific	18.89	0.18	18.39	0.18	0.50	--
Other	Asia& Pacific	3.33	0.23	3.33	0.23	--	--
Other	Europe	7.37	0.39	1.51	0.06	5.86	0.33
South Africa	Middle East & Africa	155.11	15.03	128.42	13.53	26.70	1.50
Saudi Arabia	Middle East & Africa	59.11	7.09	59.11	7.09	--	--
Nigeria	Middle East & Africa	20.68	0.71	19.68	0.66	1.00	0.05
Jordan	Middle East & Africa	10.44	0.61	10.44	0.61	--	--
Bahrain	Middle East & Africa	10.00	1.25	--	--	10.00	1.25
Other	Middle East & Africa	28.00	1.85	16.51	0.79	11.49	1.06
	Total emerging markets:	2,199.39	162.19	1,604.94	114.07	594.45	48.12
	Total sample:	19,712.39	2,836.21	11,889.70	1,843.98	7,822.69	992.23

Note: This table reports 2017 snapshot of total assets under management (AUM) and allocations to alternative asset classes ("Alts") for funds in our sample aggregated by country. All figures are in billions of US dollars. Countries with less than $10 billion in aggregate AUM in our sample are aggregated under "Other" by geographical region.

Table 2. Sample Coverage – Preqin Compared to OECD Data ($ Billions)

Country	Region	Total Assets		
		Our sample	OECD	% of OEC coverage
Developed markets:				
United States of	Americas	7,169.21	25,126.5	28.53%
Canada	Americas	1,402.25	2,403.87	58.33%
Japan	Asia & Pacific	348.37	1,598.10	21.80%
Australia	Asia & Pacific	31.91	1,523.30	2.09%
Hong Kong,	Asia & Pacific	7.30	123.10	5.93%
United Kingdom	Europe	1,425.29	2,273.71	62.69%
Netherlands	Europe	1,343.01	1,335.23	100.58%
Switzerland	Europe	600.22	904.38	66.37%
Denmark	Europe	399.30	611.90	65.26%
Germany	Europe	371.40	223.91	165.87%
Sweden	Europe	349.89	389.26	89.88%
France	Europe	127.63	230.18	55.45%
Finland	Europe	78.83	134.87	58.45%
Italy	Europe	63.25	165.24	38.28%
Spain	Europe	36.94	164.24	22.49%
Iceland	Europe	25.82	32.36	79.79%
Portugal	Europe	24.00	21.09	113.76%
Norway	Europe	22.73	37.38	60.81%
Belgium	Europe	18.21	27.56	66.08%
Austria	Europe	15.47	25.99	59.53%
Ireland	Europe	14.86	118.32	12.56%
Liechtenstein	Europe	3.62	5.21	69.54%
Israel	Middle East & Africa	133.00	177.29	75.02%
Emerging markets:				
Brazil	Americas	155.31	439.51	35.34%
Mexico	Americas	153.43	156.50	98.04%
Colombia	Americas	84.50	64.58	130.85%
Chile	Americas	80.74	174.48	46.27%
Peru	Americas	40.00	41.18	97.14%
Korea (South)	Asia & Pacific	566.25	364.63	155.29%
Thailand	Asia & Pacific	60.30	27.33	220.60%
Indonesia	Asia & Pacific	20.14	17.03	118.21%
Nigeria	Middle East & Africa	27.20	20.21	134.58%

Note: This table compares total assets of pension funds covered in our sample to the total assets of pension funds reported by OECD for the countries for which OECD data is available. Both figures correspond to 2016, which is the latest year for which coverage was available. For Norway, Belgium and Austria 2016 total assets for private pension funds not available from OECD; instead we report the latest available figures.

Table 3. Portfolio Allocations to Alternative Asset Classes (% of AUM)

Panel A: Equally-weighted averages, funds with 10 years of data (balanced panel)

Country	Region	# of funds	2008	2011	2014	2017	Δ 2008-17 (pp)	Growth
Developed markets:								
US	Americas	510	7.41	11.43	15.88	19.55	12.15	2.64 x
Canada	Americas	38	10.55	10.93	14.44	17.41	6.86	1.65 x
Japan	Asia & Pacific	12	5.10	9.24	14.60	7.88	2.78	1.55 x
Australia	Asia & Pacific	7	4.40	6.63	6.70	6.80	2.41	1.55 x
Hong Kong	Asia & Pacific	1	5.00	3.78	7.50	8.86	3.86	1.77 x
UK	Europe	207	7.54	10.74	11.85	12.45	4.92	1.65 x
Switzerland	Europe	60	7.70	19.91	20.74	22.11	14.42	2.87 x
Netherlands	Europe	35	9.30	11.64	9.81	8.99	-0.30	0.97 x
Sweden	Europe	23	12.53	14.40	16.71	19.46	6.94	1.55 x
Germany	Europe	19	4.83	9.53	11.07	13.96	9.13	2.89 x
Denmark	Europe	17	8.25	11.10	8.54	7.46	-0.79	0.90 x
Finland	Europe	15	15.93	17.42	18.90	19.39	3.46	1.22 x
Iceland	Europe	11	4.52	6.65	6.60	7.23	2.71	1.60 x
Norway	Europe	9	10.96	13.73	9.98	11.10	0.14	1.01 x
France	Europe	5	0.40	1.91	0.95	2.64	2.24	6.60 x
Italy	Europe	5	7.06	12.00	5.70	28.52	21.46	4.04 x
Austria	Europe	4	9.38	9.50	5.90	7.38	-2.00	0.79 x
Belgium	Europe	4	10.97	8.00	9.25	6.75	-4.22	0.62 x
Ireland	Europe	4	3.32	9.58	6.33	8.38	5.07	2.53 x
Spain	Europe	4	2.75	3.10	5.95	7.83	5.08	2.85 x
Portugal	Europe	3	8.67	9.02	8.19	10.17	1.50	1.17 x
Israel	Middle East & Africa	2	2.30	4.05	3.22	4.57	2.27	1.99 x
Emerging markets:								
Brazil	Americas	7	1.49	6.88	8.51	15.26	13.77	10.27 x
Chile	Americas	3	0.00	0.08	1.68	2.67	2.67	--
Puerto Rico	Americas	2	0.00	0.93	0.66	5.00	5.00	--
Peru	Americas	1	0.00	0.00	9.00	9.00	9.00	--
South Korea	Asia & Pacific	3	0.13	2.21	8.75	15.32	15.19	114.93 x
Malaysia	Asia & Pacific	2	0.20	1.21	1.10	6.50	6.30	32.50 x
Other	Asia & Pacific	4	2.50	6.63	3.16	4.18	1.68	1.67 x
Latvia	Europe	2	4.15	3.00	3.50	0.34	-3.82	0.08 x
Croatia	Europe	1	0.00	1.15	2.50	2.50	2.50	--
South Africa	Middle East & Africa	3	2.17	11.20	8.40	8.88	6.72	4.10 x
Other	Middle East & Africa	2	0.00	7.05	5.40	3.41	3.41	--

Panel B: Equally-weighted averages, funds with at least 5 years of data (unbalanced panel)

Country	Region	# of funds	2008	2011	2014	2017	Δ 2008-17 (pp)	Avg. annual change (pp)
Developed markets:								
US	Americas	962	7.30	9.96	13.82	17.69	10.39	1.45
Canada	Americas	80	10.55	9.61	13.35	14.76	4.21	0.87
Japan	Asia & Pacific	36	5.10	6.88	14.92	6.42	1.32	0.14
Australia	Asia & Pacific	7	4.40	6.63	6.70	6.80	2.41	0.27
Hong Kong	Asia & Pacific	1	5.00	3.78	7.50	8.86	3.86	0.43
UK	Europe	304	7.46	9.53	10.45	11.35	3.88	0.62
Switzerland	Europe	135	7.57	16.98	19.20	21.58	14.01	2.06
Netherlands	Europe	107	9.18	9.23	7.54	6.98	-2.19	0.27
Germany	Europe	36	4.83	9.29	10.34	13.17	8.34	1.04
Sweden	Europe	32	12.53	12.96	14.46	17.41	4.89	0.82
Denmark	Europe	21	8.25	11.30	8.95	8.11	-0.14	0.06
Norway	Europe	19	10.96	10.58	7.63	8.79	-2.16	0.17
Finland	Europe	17	15.93	16.96	17.97	18.41	2.48	0.48
Iceland	Europe	14	4.52	6.48	6.70	6.44	1.92	0.27
France	Europe	13	0.40	4.36	5.29	6.01	5.61	0.43
Belgium	Europe	11	10.97	6.43	6.51	6.46	-4.51	-0.01
Italy	Europe	11	7.06	12.40	12.07	21.87	14.81	1.36
Ireland	Europe	9	3.32	7.35	5.67	7.63	4.32	0.77
Austria	Europe	8	9.38	6.03	4.74	4.19	-5.19	-0.18
Portugal	Europe	7	8.67	7.06	10.38	8.61	-0.06	0.64
Spain	Europe	5	2.20	2.48	4.76	7.82	5.63	0.49
Liechtenstein	Europe	2	--	9.80	4.50	4.00	--	-0.88
Israel	Middle East & Africa	2	2.30	4.05	3.21	4.57	2.27	0.25
Emerging markets:								
Brazil	Americas	34	1.49	3.66	6.27	8.86	7.37	1.67
Mexico	Americas	8	--	0.00	0.10	9.91	--	0.61
Colombia	Americas	6	--	1.41	4.25	8.43	--	0.30
Chile	Americas	4	0.00	0.06	1.26	2.70	2.70	1.66
Peru	Americas	3	0.00	1.83	6.30	14.93	14.93	0.40
Puerto Rico	Americas	3	0.00	0.93	0.44	3.79	3.79	-0.06
Other	Americas	3	--	2.70	2.85	1.30	--	2.17
South Korea	Asia & Pacific	11	0.13	2.66	17.78	20.04	19.90	0.37
Malaysia	Asia & Pacific	3	0.20	1.24	1.01	5.00	4.80	0.04
Taiwan	Asia & Pacific	3	--	0.48	1.11	0.74	--	0.06
Indonesia	Asia & Pacific	2	0.00	20.00	0.00	0.50	0.50	0.14
Philippines	Asia & Pacific	2	0.00	2.30	4.00	2.40	2.40	0.19
Thailand	Asia & Pacific	2	9.00	3.25	2.38	7.50	-1.50	0.57
Other	Asia & Pacific	3	1.00	0.00	8.17	10.57	9.57	-0.42
Latvia	Europe	2	4.15	3.00	3.50	0.34	-3.82	0.41
Other	Europe	5	0.00	4.33	6.08	7.60	7.60	1.27
South Africa	Middle East & Africa	12	2.17	6.39	6.96	6.77	4.60	0.98
Botswana	Middle East & Africa	2	0.00	2.50	9.38	5.33	5.33	0.71
Oman	Middle East & Africa	2	--	0.00	1.90	3.75	--	1.59
Tanzania	Middle East & Africa	2	--	6.48	14.50	16.00	--	2.28
Other	Middle East & Africa	9	0.00	5.72	5.68	14.98	14.98	1.45

Panel C: AUM-weighted averages, funds with 10 years of data (balanced panel)

Country	Region	# of funds	2008	2011	2014	2017	Δ 2008-17 (pp)	Growth
Developed markets:								
US	Americas	510	11.80	15.36	18.15	19.28	7.47	1.63 x
Canada	Americas	38	20.75	16.86	19.59	23.94	3.20	1.15 x
Japan	Asia & Pacific	12	0.89	4.83	5.70	7.06	6.17	7.96 x
Australia	Asia & Pacific	7	1.67	3.11	6.74	7.60	5.93	4.55 x
Hong Kong	Asia & Pacific	1	5.00	3.78	7.50	8.86	3.86	1.77 x
UK	Europe	207	7.89	12.21	13.48	13.19	5.30	1.67 x
Switzerland	Europe	60	7.25	18.75	19.14	20.03	12.78	2.76 x
Netherlands	Europe	35	10.41	13.99	14.27	15.21	4.80	1.46 x
Sweden	Europe	23	6.16	8.75	13.07	17.89	11.73	2.90 x
Germany	Europe	19	4.06	11.05	11.15	18.41	14.35	4.53 x
Denmark	Europe	17	7.73	8.93	9.68	5.67	-2.06	0.73 x
Finland	Europe	15	11.22	13.79	18.60	19.42	8.20	1.73 x
Iceland	Europe	11	4.36	7.32	7.01	7.72	3.36	1.77 x
Norway	Europe	9	17.99	16.31	15.92	14.38	-3.61	0.80 x
France	Europe	5	0.06	2.08	1.72	3.40	3.35	60.34 x
Italy	Europe	5	4.14	12.72	3.12	36.73	32.59	8.87 x
Austria	Europe	4	9.61	10.92	6.13	7.74	-1.87	0.81 x
Belgium	Europe	4	13.21	8.47	9.30	6.52	-6.70	0.49 x
Ireland	Europe	4	1.09	11.23	3.51	4.20	3.11	3.85 x
Spain	Europe	4	4.53	4.55	7.83	10.07	5.54	2.23 x
Portugal	Europe	3	5.70	4.43	1.35	0.79	-4.91	0.14 x
Israel	Middle East & Africa	2	1.43	2.42	1.80	5.52	4.09	3.85 x
Emerging markets:								
Brazil	Americas	7	1.39	6.24	6.51	12.06	10.68	8.70 x
Chile	Americas	3	0.00	0.09	1.89	2.78	2.78	--
Puerto Rico	Americas	2	0.00	0.92	0.27	2.10	2.10	--
Peru	Americas	1	0.00	0.00	9.00	9.00	9.00	--
South Korea	Asia & Pacific	3	0.30	3.11	5.88	7.35	7.05	24.31 x
Malaysia	Asia & Pacific	2	0.39	2.34	2.13	5.56	5.18	14.36 x
Other	Asia & Pacific	4	3.96	8.71	3.13	5.72	1.76	1.45 x
Latvia	Europe	2	3.46	3.50	4.08	0.39	-3.07	0.11 x
Croatia	Europe	1	0.00	1.15	2.50	2.50	2.50	--
South Africa	Middle East & Africa	3	1.45	11.45	8.12	8.42	6.98	5.83
Other	Middle East & Africa	2	0.00	5.63	4.34	2.91	2.91	--

Panel D: AUM-weighted averages, funds with at least 5 years of data (unbalanced panel)

Country	Region	# of funds	2008	2011	2014	2017	Δ 2008-17 (pp)	Avg. annual change (pp)
Developed markets:								
US	Americas	962	11.63	14.82	17.18	17.69	18.70	0.87
Canada	Americas	80	20.75	13.30	17.08	14.76	20.33	0.42
Japan	Asia& Pacific	36	0.89	4.84	5.73	6.42	5.83	0.65
Australia	Asia& Pacific	7	1.67	3.11	6.74	6.80	7.60	0.66
Hong Kong	Asia& Pacific	1	5.00	3.78	7.50	8.86	8.86	0.43
UK	Europe	304	7.89	11.96	13.45	11.35	13.41	0.76
Switzerland	Europe	135	7.20	17.78	18.90	21.58	20.27	1.65
Netherlands	Europe	107	10.36	11.93	11.63	6.98	12.39	0.73
Germany	Europe	36	4.06	10.27	9.32	13.17	14.04	1.35
Sweden	Europe	32	6.16	8.61	12.71	17.41	17.32	1.27
Denmark	Europe	21	7.73	9.49	10.01	8.11	6.69	-0.06
Norway	Europe	19	17.99	14.13	14.36	8.79	13.65	-0.20
Finland	Europe	17	11.22	13.76	18.52	18.41	19.33	0.91
Iceland	Europe	14	4.36	7.38	7.20	6.44	7.16	0.29
France	Europe	13	0.06	4.01	4.87	6.01	5.65	0.47
Belgium	Europe	11	13.21	4.73	4.06	6.46	4.04	-0.49
Italy	Europe	11	4.14	6.98	21.09	21.87	27.09	2.46
Ireland	Europe	9	1.09	8.54	5.03	7.63	9.65	1.53
Austria	Europe	8	9.61	5.53	2.94	4.19	5.46	0.13
Portugal	Europe	7	5.70	4.72	6.46	8.61	3.88	-0.20
Spain	Europe	5	3.86	3.88	6.68	7.82	10.07	0.56
Liechtenstein	Europe	2	--	9.80	6.72	4.00	6.54	-0.39
Israel	Middle East & Africa	2	1.43	2.42	1.80	4.57	5.52	0.45
Emerging markets:								
Brazil	Americas	34	1.39	5.08	5.97	9.79	8.40	1.06
Mexico	Americas	8	--	0.00	0.07	10.37	--	1.73
Colombia	Americas	6	--	1.19	4.03	8.68	--	0.71
Chile	Americas	4	0.00	0.09	1.88	2.78	2.78	0.31
Peru	Americas	3	0.00	3.76	5.72	18.04	18.04	2.00
Puerto Rico	Americas	3	0.00	0.92	0.13	1.68	1.68	0.12
Other	Americas	3	--	2.65	2.72	1.17	--	0.02
South Korea	Asia & Pacific	11	0.30	3.04	7.41	7.86	7.56	0.83
Malaysia	Asia & Pacific	3	0.39	2.33	2.11	5.51	5.13	0.56
Taiwan	Asia & Pacific	3	--	0.08	0.56	0.42	--	0.06
Indonesia	Asia & Pacific	2	0.00	20.00	0.00	0.59	0.59	0.07
Philippines	Asia & Pacific	2	0.00	2.81	4.00	2.94	2.94	0.17
Thailand	Asia & Pacific	2	9.00	1.76	1.28	5.20	-3.80	0.11
Other	Asia & Pacific	3	1.00	0.00	4.98	5.79	4.79	0.36
Latvia	Europe	2	3.46	3.50	4.08	0.39	-3.07	-0.34
Other	Europe	5	0.00	3.44	6.18	8.09	8.09	0.58
South Africa	Middle East & Africa	12	1.45	1.02	1.18	9.78	8.33	3.29
Botswana	Middle East & Africa	2	0.00	2.50	4.14	2.83	2.83	0.43
Oman	Middle East & Africa	2	--	--	--	--	--	--
Tanzania	Middle East & Africa	2	--	1.19	7.12	7.15	--	0.99
Other	Middle East & Africa	9	0.00	7.10	2.45	6.65	6.65	1.47

Note: This table shows the evolution of the allocations to alternative asset classes from 2008-2017. Numbers correspond to averages across pension funds operating in a given country. In Panels A and B, all funds within a given country are equally weighted. In Panels C and D, numbers for individual funds are weighted by 2008 AUM. Countries with data for only one fund are aggregated under "Other" by geographical region.

Table 4. The Role of the Fund Size

Panel A: Size deciles

Size percentile	Mean 2008 AUM ($ billion)	Alts holdings (% of AUM)		Diff. (2017-2008)	
		2008	2017		
1	0.049	2.76	9.27	6.50	***
2	0.153	3.04	11.95	8.91	***
3	0.328	5.57	9.93	4.36	***
4	0.576	7.10	10.92	3.81	***
5	0.913	5.16	11.77	6.61	***
6	1.400	7.49	12.28	4.79	***
7	2.136	8.21	12.58	4.37	***
8	3.613	6.41	12.97	6.56	***
9	7.463	7.21	13.11	5.90	***
10	56.365	9.57	13.16	3.59	***
Diff.	(10) - (1)	6.81 ***	3.90 ***		

Panel B: Within-country analysis

Dependent variable:	Average annual change in Alts holdings, 2017-2008			
	Funds with at least 5 years of data		Funds with 10 years of data	
	(1)	(2)	(3)	(4)
2008 AUM ($billion)	-0.0049**	-0.0041*	-0.0040**	-0.0050**
	[0.002]	[0.002]	[0.002]	[0.002]
Constant	1.11***	1.11***	1.03***	1.03***
	[0.046]	[0.044]	[0.047]	[0.044]
Fixed effects: Country	--	Yes	--	Yes
Observations	1,940	1,940	1,025	1,025
R-sq.	0.002	0.1152	0.004	0.139

Note: This table shows the relation between pension funds sizes and the 2008-2017 evolution of allocations to alternative asset classes ("Alts") expressed as a % of AUM. Panel A shows a non-parametric analysis sorted in size deciles based on 2008 AUM. Panel B allows for inclusion of country fixed effects. ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively.

Table 5. Public vs. Private Pension Funds (% of AUM)

Panel A: Funds with 10 years of data (balanced panel)

| Country | Region | Equally-weighted | | | | | | Value-weighted | | | | | |
| | | Public funds | | | Private funds | | | Public funds | | | Private funds | | |
		# of funds	Δ 2008-17 (pp)	Growth	# of funds	Δ 2008-17 (pp)	Growth	# of funds	Δ 2008-17 (pp)	Growth	# of funds	Δ 2008-17 (pp)	Growth
Developed markets:													
US	Americas	300	12.27	2.27 x	210	11.96	3.88 x	300	6.12	1.35 x	210	9.14	2.80 x
Canada	Americas	18	5.82	1.31 x	20	7.80	3.44 x	18	0.56	1.02 x	20	8.05	6.78 x
Australia	Asia & Pacific	2	8.07	--	5	0.14	1.02 x	2	8.05	--	5	1.47	1.28 x
UK	Europe	91	4.87	1.50 x	116	4.95	1.85 x	91	4.83	1.46 x	116	5.46	1.78 x
Switzerland	Europe	18	16.04	3.05 x	42	13.72	2.80 x	18	11.96	2.70 x	42	13.59	2.82 x
Denmark	Europe	12	0.93	1.13 x	5	-4.92	0.57 x	12	-2.22	0.69 x	5	-1.00	0.91 x
Iceland	Europe	10	1.83	1.40 x	1	11.50	4.29 x	10	3.11	1.71 x	1	11.50	4.29 x
Sweden	Europe	8	0.56	1.03 x	15	10.34	2.03 x	8	7.21	1.79 x	15	15.10	4.85 x
Netherlands	Europe	6	-7.53	0.56 x	29	1.19	1.16 x	6	7.70	1.77 x	29	0.47	1.04 x
Finland	Europe	4	3.99	1.24 x	11	3.27	1.21 x	4	4.91	1.37 x	11	14.30	3.02 x
Germany	Europe	4	14.09	2.37 x	15	7.81	3.32 x	4	24.07	6.42 x	15	7.32	2.93 x
Norway	Europe	3	2.89	1.22 x	6	-1.23	0.88 x	3	-3.45	0.83 x	6	-3.89	0.72 x
France	Europe	2	6.60	--	3	-0.67	--	2	4.17	--	3	-0.31	--
Israel	Middle East & Africa	1	5.00	6.00 x	1	-0.46	0.87 x	1	5.00	6.00 x	1	-0.46	0.87 x
Emerging markets:													
Brazil	Americas	2	18.55	4.57 x	5	11.86	--	2	16.43	3.06 x	5	9.47	--

Panel B: Funds with at least 5 years of data (unbalanced panel)

Country	Region	Equally-weighted						Value-weighted					
		Public funds			Private funds			Public funds			Private funds		
		# of funds	Δ 2008-17 (pp)	Annual Δ (pp)	# of funds	Δ 2008-17 (pp)	Annual Δ (pp)	# of funds	Δ 2008-17 (pp)	Annual Δ (pp)	# of funds	Δ 2008-17 (pp)	Annual Δ (pp)
Developed markets:													
US	Americas	444	10.55	1.45	518	11.47	1.53	444	6.38	0.67	518	9.25	1.13
Canada	Americas	40	-0.29	0.55	40	7.89	1.14	40	-6.62	0.12	40	8.67	0.97
Japan	Asia & Pacific	3	0.83	0.09	33	1.36	0.15	3	0.94	0.10	33	10.04	1.31
Australia	Asia & Pacific	2	8.07	0.90	5	0.14	0.02	2	8.05	0.89	5	1.47	0.16
UK	Europe	104	4.39	0.58	200	4.16	0.65	104	4.57	0.56	200	6.00	0.83
Switzerland	Europe	50	15.81	2.77	85	12.90	1.72	50	12.69	1.68	85	13.44	1.62
Denmark	Europe	12	0.93	0.10	9	-2.93	0.07	12	-2.22	-0.25	9	2.15	0.68
Iceland	Europe	12	0.92	0.11	2	8.35	1.18	12	2.55	0.26	2	11.32	1.27
Netherlands	Europe	12	-10.46	-0.52	95	-0.56	0.41	12	6.85	0.85	95	-1.29	0.50
Sweden	Europe	12	-0.48	0.35	20	7.80	1.07	12	6.51	0.79	20	14.72	1.65
Germany	Europe	8	10.26	1.32	28	7.69	0.96	8	22.09	2.54	28	4.88	0.71
France	Europe	7	8.69	0.61	6	2.21	0.24	7	6.75	0.54	6	1.69	0.18
Norway	Europe	6	1.16	0.61	13	-3.62	-0.05	6	-4.22	-0.23	13	-4.39	-0.20
Finland	Europe	5	4.32	0.69	12	1.68	0.36	5	4.93	0.55	12	14.01	1.59
Italy	Europe	3	12.76	1.37	8	16.46	1.31	3	26.65	2.85	8	23.35	1.76
Austria	Europe	2	-7.00	0.00	6	-4.58	-0.21	2	-2.22	-0.14	6	-3.16	0.21
Belgium	Europe	2	-4.50	-0.17	9	-4.50	0.02	2	0.05	0.10	9	-10.62	-0.65
Portugal	Europe	2	-3.75	-0.28	5	0.95	1.15	2	-3.50	-0.39	5	-4.21	0.32
Israel	Middle East & Africa	1	5.00	0.56	1	-0.46	-0.05	1	5.00	0.56	1	-0.46	-0.05
Emerging markets:													
Brazil	Americas	3	15.92	1.69	31	0.00	1.12	3	2.84	1.61	31	0.00	0.98
South Africa	Middle East & Africa	4	7.10	1.14	8	3.68	1.26	4	2.60	3.22	8	4.65	1.44

Note: This table shows the evolution of allocations to alternative asset classes between 2008 and 2017 separately for public and private pension funds, as identified in Preqin.

Table 6. Portfolio Composition of U.S. Defined Benefit Funds (% of AUM)

Panel A: Overall portfolio

Year	# of funds	Cash and cash equivalents			Fixed income			Domestic public equity			Alts (Total)		
		Median	Mean	Std. dev.	Median	Mean	Std. dev.	Median	Mean	Std. Dev.	Median	Mean	Std. dev.
2006	361	1.60	3.00	5.26	26.38	26.77	9.16	45.61	44.76	10.70	4.40	5.95	6.71
2007	376	1.31	2.78	5.21	25.00	24.89	9.44	44.02	43.27	11.54	5.00	6.95	7.68
2008	392	1.52	2.75	4.16	29.00	30.24	12.03	39.00	37.94	12.39	6.68	8.50	8.59
2009	211	1.50	2.52	3.04	28.75	30.24	9.97	35.95	35.36	11.23	8.30	9.71	8.22
2010	217	1.30	2.09	2.34	29.62	31.24	10.97	32.50	32.96	10.99	9.08	10.73	8.83
2011	198	1.30	2.16	2.11	28.90	30.81	10.65	29.71	30.62	10.78	12.50	13.26	10.18
2012	199	1.20	2.15	2.63	26.90	28.98	10.00	29.00	30.39	11.39	13.30	13.82	9.61
2013	178	1.22	1.97	2.68	24.75	27.40	10.97	28.15	30.00	11.39	13.03	14.24	9.24
2014	159	1.30	2.09	3.96	25.40	27.91	12.08	27.59	28.17	11.44	14.32	14.64	8.52
2015	152	1.20	2.02	2.30	25.80	29.30	14.02	26.00	26.90	11.42	15.07	15.40	8.83
Δ 2015-2006		-0.4	-1.0	**	-0.6	2.5	*	-19.6	-17.9	***	10.7	9.4	***
Δ 2015-2008		-0.3	-0.7	**	-3.2	-0.9		-13.0	-11.0	***	8.4	6.9	***

Panel B: Alts composition

Year	# of funds	Private equity			Real estate			Hedge funds			Other		
		Median	Mean	Std. dev.	Median	Mean	Std. dev.	Median	Mean	Std. Dev.	Median	Mean	Std. dev.
2006	361	0.20	2.18	3.20	2.00	3.49	4.29	0.00	0.21	2.31	0.00	0.06	0.41
2007	376	1.00	2.62	3.72	2.12	3.56	4.13	0.00	0.63	3.11	0.00	0.14	0.72
2008	392	1.40	3.40	4.48	2.95	4.41	4.97	0.00	0.45	2.49	0.00	0.25	0.93
2009	211	3.00	4.21	4.59	4.00	4.52	3.88	0.00	0.64	2.73	0.00	0.34	1.16
2010	217	3.20	4.70	5.09	4.00	4.19	3.34	0.00	0.90	3.19	0.00	0.96	1.85
2011	198	4.00	5.66	5.91	5.00	5.32	4.06	0.00	1.15	3.76	0.00	1.13	2.05
2012	199	4.60	5.61	5.28	5.31	5.66	3.96	0.00	1.36	4.51	0.00	1.19	2.02
2013	178	5.00	5.77	5.01	5.40	5.91	3.97	0.00	1.53	4.55	0.00	1.02	1.70
2014	159	5.90	6.17	4.72	6.00	6.19	3.77	0.00	1.26	3.72	0.00	1.02	1.59
2015	152	5.89	6.47	4.90	6.35	6.77	4.25	0.00	1.16	3.65	0.00	1.01	1.49
Δ 2015-2006		5.7	4.3	***	4.4	3.3	***	0.0	0.9	***	0.0	0.9	***
Δ 2015-2008		4.5	3.1	***	3.4	2.4	***	0.0	0.7	***	0.0	0.8	***

Note: This table shows the evolution of the portfolio for U.S. defined benefit funds using data from Pension & Investments 1000. These figures only account for domestic public equity. The residual corresponds to international public equity. Panel B presents the composition of Alternatives. Investments in Timber, Infrastructure, and Commodities are aggregated under "Other."

Table 7. Portfolio Allocations to Alternative Asset Classes and Interest Rates Environment

Dependent variable	Average annual change in Alts share (% AUM), 2008-2017			
	(1)	(2)	(3)	(4)
Natural rate	-0.4602**	-0.3574*	-0.4938**	-0.5301**
	[0.179]	[0.190]	[0.202]	[0.232]
GDP growth	0.3058	0.3001	0.4140	0.4140
	[0.215]	[0.215]	[0.258]	[0.254]
Inflation	--	-0.2691	--	0.1237
		[0.265]		[0.357]
AUM	-0.0048*	-0.0050*	-0.0049	-0.0047
	[0.003]	[0.002]	[0.004]	[0.004]
Constant	0.8075	1.2191***	0.6658	0.4759
	[0.469]	[0.402]	[0.523]	[0.522]
Observations	867	867	1,595	1,595
R-sq.	0.048	0.050	0.037	0.037

Note: All explanatory variables correspond to five-year average. That is, *Natural rate* is the average natural rate for 2012-2016, *GDP growth* and *Inflation* correspond to annual growth rates over the sample period. Columns (1) and (2) are for the sample of funds with 10 years of data. Columns (3) and (4) are for the sample of funds with at least 5 years of data. Natural rates are available for U.S., Canada, Euro Area, U.K. and Japan. Sample includes a snapshot of funds (i.e., pure cross-section). Standard errors are clustered at the country level. ***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively.