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Pension Funds and Private Equity Real Estate: History, Performance, Pathologies, Risks

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Abstract

I study the history and performance of commercial real estate (CRE) in the pension fund portfolio, showing how many plan sponsors fundamentally changed their approach to CRE investment once underfunding gaps began to emerge in the early and middle 2000s. Several new empirical facts are presented, including pension fund share ownership estimates of private equity real estate (PERE) in excess of 50%, reconfirmation of underperformance of Value-add and Opportunity PERE funds, and the apparent existence of an illiquidity price premium paid by pension funds for the "volatility veil" that PERE fund investment provides. Three types of concentration risks are identified, including high geographical ownership concentrations. I argue the risks that pension funds and their investment in PERE funds pose to economic and financial stability have been exacerbated by the negative aftershocks of the COVID-19 pandemic.

[1] I wish to thank Da Li for his excellence research assistance. I also want to thank Greg Brown, Jeff Fisher, Charles Leung, Joe Pagliari, Calvin Schnure, and David Shulman for their helpful input and suggestions. This is not meant to implicate anyone, as all views, opinions, mistakes and other shortcomings are mine alone.

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I. Introduction and Overview

There is an estimated $60 trillion of commercial property in the world, $12 trillion of which is located in the US (LaSalle Investment Management (2018), Ghent et al. (2019)). Commercial real estate (CRE) as an asset class is, in the US, larger than both the Treasury and corporate bond markets, and about half the size of both the stock market and the stock of residential real estate. Not all CRE is "investable," however. Ghent et al. (2019) estimate that approximately two-thirds of all CRE is owned by firms and other organizations to be deployed as a factor of their own production.

OECD data show that as of year-end 2018 there are $16 trillion of assets held by all US pension plans. Of this, approximately $9 trillion belongs to defined benefit (DB) pension funds. Portfolio allocations of DB pension fund assets to CRE in the US are now in excess of 9%, implying that DB pension funds own approximately 20% of all investable CRE in the US.[2]

CRE is clearly a big and important asset class, and pension funds are clearly big and important investors. Moreover, CRE and pension funds overlap with one another in important ways, having had a long and sometimes tumultuous relationship. Yet, although they have been much studied on their own, they have been little studied in combination, particularly from historical, macroeconomic and policy perspectives.[3]

Pension funds and CRE have a symbiotic, strongly codependent relationship. CRE that sits inside private equity (PE) fund investment vehicles has become increasingly important to pension funds as many struggle with underfunding problems. These underfunding problems – which began to emerge in the early-middle 2000s, largely caused by a combination of generous retirement benefit

[2] The 20% market share comes from $4 trillion of investable CRE in the US, with a bit over $0.8 trillion of pension fund assets allocated to CRE. Pension fund assets and DB shares for many countries in the OECD data are either missing or unreliable, so I omit a global analysis. But given pension fund interest in CRE located around the world (primarily in gateway-superstar city markets, where much of the value is concentrated), global ownership percentages are probably similar to those of the US.

[3] For example, private CRE fund performance has been much studied, using primarily NCREIF data. But pension fund motives and investment objectives are generally either taken for granted or ignored. Ghent (2020) is a recent exception. I will emphasize the influence that pension fund investment has had on investment vehicle fund structure and performance, which has received little attention. There are some good articles from a macro-historical perspective that were written in the 1990s and early 2000s, but not much to my knowledge has been done since; see, e.g., Winograd (2004).

promises and mediocre investment performance – have created strong incentives for many pension funds to reach for return. They do so by targeting investments with high expected returns, with less focus on the risks of investment. PE has been the favored higher-return investment vehicle for plan sponsors, and real estate has for over 40 years been the favored category of investment within PE.

Within private equity real estate (PERE), the favored strategies in recent years have been so-called Value-add and Opportunity funds.[4,5] These funds purchase risky CRE assets – either ground-up development or projects requiring significant redevelopment. Moreover, these funds typically deploy leverage in the 50% to 70% range, targeting net-of-fee IRRs of 13% to 18%.

To date these funds have not delivered returns that were promised at the time of investment. Bollinger and Pagliari (2019) estimate that over their 2000-2017 sample period, Value-add and Opportunity funds underperform on a risk-adjusted basis by about 3% a year. In analyzing data over the same time frame, but using different data sources and methods, Gupta and Van Nieuwerburgh (2019) estimate that PERE funds underperform by 3-4% a year. My own analysis contained herein shows significant underperformance relative to the public market alternative in the pre-GFC time period from 2001 to 2008, with post-GFC returns to Value-add and Opportunity funds that are at or below target. Perhaps most informative is a simple comparison of returns to owning the NCREIF (private core CRE fund investment) versus NAREIT (the public market CRE investment alternative) indices. From 1978 to 2019, NCREIF has returned 9.13% per year on average while NAREIT has returned 12.45%. This is over a 3% difference per year, where, over a 42-year time period, holding the NAREIT index would have generated *three times* the wealth of holding the NCREIF index.

Evidence from several sources thus indicates that pension funds are willing to accept a 3% to 4% *discount* in their rate of return for the PE fund investment vehicle wrapper – a wrapper that hinders price discovery and veils true asset volatility. This willingness by pension funds to commit capital to GP's that overpay for CRE assets held in opaque investment vehicles is anomalous, presenting risks to society at large. Given the structural underfunding problems experienced by many DB plan sponsors, this behavior has close analogies to the well-known gambler's ruin problem – but worse. The eventually bankrupt gambler – public pension funds that will require a bailout because they are unable

[4] According to a recent article published in the PREA Quarterly ("Leveraging History," Spring 2020), 60% of PERE fund investors favor Value-add funds and 23% favor Opportunistic. My own data from Preqin indicates that 85%, of PERE funds with vintage dates from 2009 to 2019 are classified as Value-add or Opportunistic.

[5] Throughout this article, I am going to slightly abuse standard terminology by using PERE to mean any type of CRE equity fund that pension funds will consider for investment. This includes open-end core funds to closed-end value-add and opportunity funds. I will specifically refer to NCREIF when I am primarily thinking of open-end core investment funds.

to pay retirement benefits as promised – will in all likelihood make the bailout request of taxpayers during hard economic times when marginal utilities of consumption are particularly high.[6]

I document several concentration risks that exist with pension funds and their investment in CRE. First, there is increasing concentration in PE fundraising among fewer GP-sponsors, the most prominent of which is Blackstone. Second, I estimate a DB pension plan ownership share in PERE funds that is in the 50% range. Third, there is surprisingly high institutional investor ownership shares of CRE assets concentrated in Top-10 gateway-superstar cities located around the world and in the US. These densely populated urban areas are particularly vulnerable to the negative CRE asset pricing shocks following from the COVID-19 pandemic, as preliminary evidence from Ling et al. (2020) indicates. I argue that the cumulative effect of these concentration risks, combined with the significant leverage employed in PERE and PE more broadly, pose meaningful threats to economic and financial stability.

This paper is organized as follows. In section II, I start with a short history of the long marriage between pension funds and CRE that covers the 1974 to 1992 time period. Here, I focus on the implications of ERISA on pension plan sponsor investment behavior. I also document the early performance of CRE investment fund vehicles, as well as some puzzling economic relationships. Section III covers the 1993 to 2008 time period. Here, I document the emergence of the public markets as capital sources to fund CRE investments. Growth in alternative investments is also considered. I further describe early academic studies that revealed the extent of the structural pension plan underfunding problem. Section IV contains many of the paper's main findings. I analyze pension fund portfolio allocations to PERE as well as realized investment performance, focusing on the 2001 to 2019 time period. I combine my own analysis with that of existing studies to establish PERE underperformance. The critical distinction between alpha and beta is addressed, as well as the apparent negative illiquidity risk premia that exist with private CRE fund investment. Section V concludes by documenting GP ownership, LP ownership and geographic ownership concentrations noted above, with arguments that the structural pension underfunding problem presents some very real economic and financial instability risks.

[6] Novy-Marx and Rauh (2009) made a similar point more than 10 years ago. At the time of writing (August 2020), there is much political discussion about implications of the COVID-19 pandemic on the financial health of multi-employer pension funds at a time when so many other economic stresses exist. For example, a 5/13/20 Wall Street Journal article entitled "Public Pension-Fund Losses Surpass Worst From '08 Crisis," provides a quote from Don Boyd, co-director of the State and Local Government Finance Project at the University of Albany's Rockefeller College, stating: "There will be a lot of pressure to cut [retirement] benefits… State and local governments are trying to figure out how to not cut school aid too deeply, not cut Medicaid too deeply, not raise taxes. Pension contributions are pretty far down the list of things they want to pay for."

II. 1974 – 1992: ERISA and the Real Estate Alternative

II.A. ERISA and the Great Inflation

The emergence of real estate investment by US pension funds can be traced back to 1974 with the passage of landmark Employee Retirement Income Security Act, or ERISA. ERISA set legal standards for participation, vesting, benefit accrual and the funding of defined benefit (DB) retirement plans.[7] Among other things, the legislation identified pension plan sponsors as fiduciaries with legal duties to act in the best interests of their plan participants.

Analogous to the better known business judgement rule, ERISA's *prudent man rule* allowed plan sponsors to take investment risks on behalf of plan participants, with the potential of incurring investment losses, as long as they acted in the best interests of plan participants. Given these new and yet untested legal requirements, plan sponsors had strong incentives to elevate compliance over risk-taking in asset portfolio management. This in turn caused plan sponsors to establish investment processes and compliance standards, with everything blessed by third-party consultants.

Indeed, these processes and standards caused a strong initial focus on wealth preservation and conservative risk management, which almost immediately led plan sponsors to mimic one another's investment approaches. They could, in other words, reduce their risks of breaching fiduciary duty by herding with respect to their investment processes and asset allocation decisions. Given the new legal-regulatory landscape, it was far better to fail with a great deal of company than to go it alone, acting as a pioneer in search of alpha through some exotic investment strategy.

In addition to encouraging conformance amongst plan sponsors, there was an almost religious adherence to the application of classical portfolio theory. Conformity to this orthodoxy generated additional legal cover for the plan sponsors, having the advantage of looking formal and scientific in the context of complying with established investment practices.

Prior to the late 1970s pension plan sponsors allocated nearly 100 percent of fund assets to public equities and traditional fixed-income securities. But the oil supply shocks and the Great Inflation of the 1970s changed that mindset. With inflation and treasury rates running into the double digits, stock and bond portfolios were simultaneously devastated.

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[7] For more on ERISA, see, among other possible sources, https://www.investopedia.com/terms/e/erisa.asp. Defined benefit retirement plans are distinct from defined contribution (DC) retirement plans. With DB plans, investments are made by the plan sponsor on behalf of plan participants. There are pre-specified formulas that determine retirement benefits to be paid to retirees. DC plans are, in contrast, participant self-directed, often chosen from a menu of investment alternatives provided by the employer. No preset formulas are applied, nor are there promises of payouts made to the participant in advance. See, among, many others, Novy-Marx and Rauh (2009) for more on this distinction.

This caused plan sponsors to consider alternative asset classes that might supply some insurance against broad economic shocks. Just such an alternative seemed to exist in the form of real estate, which performed marvelously during these dark times. As Leombroni et al. (2020) have recently documented, and as many observers recognized at the time, relative wealth shifted significantly from stocks to real estate during the middle 1970s – see Figure 1. As the figure shows, the shift was substantial and fairly permanent. The clear implication was that prudent investment management demanded exposure to real estate in the pension fund asset portfolio.

FIGURE 1 ABOUT HERE

II.B. Putting the Pieces in Place

Although there seemed to be a lot of real estate available for investment, nobody really knew how much. Moreover, there were important differences between owner-occupied housing, which at the time was not investable, and income-producing commercial real estate, which was.[8] Nor were there any studies of longer-run term investment performance of real estate, which would be necessary to document portfolio investment relations and to assess the robustness of recent performance. There was also the issue of what sort of investment vehicle would be required to accommodate private asset ownership. And finally there was the question of how to measure relative investment performance. Although well known indices such as the Dow Jones Industrial Average existed to benchmark stock performance, no industry-specific benchmarks existed for private real estate investment.

The first two questions of how much real estate there was and how did it perform were tackled together in a study authored by Ibbotsen and Siegel (1984). Key findings are displayed in Figure 2 and Table 1. Panel A of Figure 2 shows that, over a 36-year time period covering 1947 to 1982, the share of real estate in the US was approximately that of all stocks, bonds and Treasury securities combined. Even if all of this real estate was not actually investable, a meaningful percentage had to be.[9] Also notable is the share shift that occurred between real estate and stocks in the middle 1970s, as previously highlighted in Figure 1.

FIGURE 2 ABOUT HERE

TABLE 1 ABOUT HERE

[8] See Ghent et al. (2019) and LaSalle Investment Management (2018) for more recent estimates on the size of the investable CRE market. Current estimates are that there is between $12 and $16 trillion of investable CRE in the US. Global estimates are more varied, ranging from the low $30's to closer to $60 trillion.

[9] The real estate data included residential, commercial and farmland. Interestingly, the size weights of the three components are never disclosed, so one does not know the relative share of commercial property within the index. Also, the commercial return data do not start until 1960, whereas both the residential and farmland data go back to 1947.

Moreover, as seen in Panel B of Figure 2 and Panel A of Table 1, investment performance of real estate over the longer-run was quite respectable. Average annual returns of 8 percent were smack dab in between returns to stocks and bonds. In addition, real estate showed remarkable stability in returns over time, attributable in part to stable operating income streams. And perhaps most importantly, as seen in Panel B of Table 1, the data showed that real estate returns were essentially uncorrelated with stock and bond returns. This latter relation seemed to confirm the insurance-like qualities displayed by real estate during the Great Inflation of the 1970s. The impact of this study was immediate and widespread, stoking an already burning interest in real estate investment.

Ironically, in light of ERISA's prudent man fiduciary rule, it was the Prudential Insurance Company that led the way in developing vehicles that facilitated investment in CRE. The company had its own portfolio of CRE, from which it took its better located, newer, higher quality office, retail, warehouse and apartment properties (later labeled as *core assets*) and placed them into what was then referred to as a *open-end commingled real estate fund*.[10] Prudential would manage the fund as the general partner (GP) that earned fees as a percentage of assets under management, with plan sponsors investing as limited partners (LPs). Prudential's early offerings of core commingled CRE funds are one of the earliest known GP-LP structured private equity investment vehicles marketed to institutional investors.

The last piece of the CRE investment puzzle was to create an index with which to benchmark relative performance. The Russell-NCREIF index (now simply known as the NCREIF index) was publicly introduced in 1983, with performance dating back to 1978.[11] The index was immediately deemed an acceptable industry performance benchmark, and remains widely used to this day.

II.C. Early Performance

In the early 1980s, with green lights flashing go, and plenty of consultants and processes put into place to demonstrate fiduciary duty, plan sponsors began dipping their toes into CRE investment through the open-end commingled fund vehicle. Coincidently they did so right at the front end of what was the biggest CRE development boom of the 20th century. This building boom, which shaped the skylines of many major US cities for decades to come, ended badly and became known as the Savings

[10] Prudential formed the first commingled real estate fund vehicle in 1970, called the Prudential Property Investment Separate Account, or PRISA. Note that PRISA conveniently rhymes with ERISA.
[11] NCREIF stands for the National Council of Real Estate Investment Fiduciaries. For additional information, see ncreif.org.

& Loan crisis. Fortunately for most pension funds, there was not much CRE exposure yet. The building boom and bust did, however, reveal a dark side of the industry that shook plan sponsor confidence regarding the stability of CRE cash flows and asset prices.

Using annual return data, Figure 3 displays the NCREIF index versus the NAREIT index from 1978 through 1992. The NAREIT index is composed of publicly listed firms (Real Estate Investment Trusts, or REITs) that own income-producing commercial real estate (so-called equity REITs). Thus both indices reflect returns to the commercial real estate sector. During the 1978-1992 time period NCREIF assets were weighted more heavily towards higher quality office buildings located in larger metropolitan areas. The general quality of the (core) assets held in the NCREIF index was probably higher than that held in the NAREIT index, with some additional differences in location. REITs also tended to employ quite a bit more leverage than NCREIF assets at the time.

FIGURE 3 ABOUT HERE

Table 2 shows that the performance differential over this 15-year period is significant: 9.42% for NCREIF versus 15.28% for NAREIT. NCREIF returns are reported prior to accounting for fees, estimated to be between 1.0% and 1.5% per year, whereas NAREIT returns are net of fees (known as General and Administrative expenses, or G&A). Thus, on a net-of-fee basis, annualized return differences are approximately 7% per year. As highlighted by Riddiough et al. (2005), adjusting for property type and leverage differences do not fully account for the return differential.[12] Furthermore, equity REIT ownership interests are generally liquid, since shares are exchange-traded, whereas LP interests in commingled CRE funds are much less so.[13]

TABLE 2 ABOUT HERE

II.D. Puzzling Relations

Differences in investment performance are not the only interesting feature of the data. As seen in Table 2, the standard deviation of returns to the NCREIF Index are nearly half that of the NAREIT index. Differences in the autocorrelation of returns are striking – near one for NCREIF and near zero

[12] After adjusting for property type and leverage, as well as fees, Riddiough et al. (2005) are left with a 3% difference over a sample period covering 1980-98. Prior to these adjustments the differential was 4%, suggesting the pre-adjustment difference is smaller in the 1980-98 window than over the 1978-92 time period covered here. Pagliari et al. (2005) come to similar conclusions, but make the point that due to the low number of (quarterly) time series observations the differences were not statistically significant.

[13] Open-end commingle funds did advertise redemption on a quarterly basis, suggesting a certain degree of liquidity. But the S&L crisis revealed that LP share liquidity was largely illusory. This followed because, when investors demanded liquidity as a result of the industry downturn, redemptions were often denied because LPs were all requesting redemptions at the same time and in a depressed asset market that itself was highly illiquid.

for NAREIT. The cross-correlations are also eye-catching. On a contemporaneous basis the correlation between NCREIF and NAREIT returns is only .167, suggesting very little relation between listed firms and private funds that hold highly similar assets. However, when time *t* returns from NCREIF are correlated with time *t*−1 returns from NAREIT, the cross-correlation increases to .357. Clearly there is something strange going on in the data.

It turns out that most of the puzzling relations found in Table 1, as well as those seen in Figure 2 and Table 2, can be attributed to a*ppraisal smoothing*. Seminal studies authored by Geltner (1991) and Ross and Zisler (1991) highlight the fact that CRE assets sold infrequently with updates coming primarily through appraisals. They document that appraisers exhibit valuation behavior at odds with the forward-looking approach that investors take in informationally efficient stock markets. Rather than engage in price discovery as described by Fama (1970), appraisers heavily anchor on prior period appraised values. The resulting updated valuation estimates are smoothed relative to their "full information" values, leading to significant lags in prices. In other words, appraisal smoothing artificially depresses return volatility and correlations.[14]

Insights gained from appraisal smoothing can explain most but not quite all of the puzzling relations documented in Table 2. The return differential – which has narrowed over time but remains to this day a robust relation – indicates that institutional investors are willing to accept net-of-fee returns on their core CRE investments that are somewhere between .50% and 5% less than those realized from holding a diversified portfolio of REIT stocks.[15] This does not include compensation for illiquidity risk, which some have estimated to be on the order of about 3% per year (see, e.g., Franzoni et al. (2012)).

[14] Ibbotson and Siegel (1984) recognize that value estimates were largely appraisal-based and that returns in their index were smoothed. But they do not address the implications of smoothing for variance and covariance calculations.

[15] For more recent estimates at the low end of the range, see Ling and Naranjo (2015). They carefully match by property type and location to control for risk differences. I will note that compositional differences between the NCREIF and NAREIT indices have increased over time based on property type. NAREIT is now partly comprised of "tech oriented" CRE such as life sciences, infrastructure (e.g., cell towers) and data centers. This is clearly not traditional core real estate exposure, but it does reflect the shifting role of CRE in the modern economy. There are also leverage differences between NCREIF and NAREIT, but these have narrowed significantly over the last 15 years. Fee estimates for core open-end fund investment are now in the 1.0% to 1.5% range, rather than 80 basis points previously assumed. In the end, despite their differences, given the difficulties in accurately measuring true return variances and co-variances to private direct CRE investment, it is not clear to me whether investment in the NAREIT index is any riskier than investment in NCREIF. As will be discussed in greater detail later in this paper, recent events indicate that core investment concentrated in urban gateway markets (as reflected in NCREIF) is actually quite a bit riskier than investment in the better diversified NAREIT index.

III. 1993–2008: Shifting Capital Sources, The Rise of Alternatives, and the Emergence of the Pension Underfunding Problem

Within the 16-year window from 1993 to year-end 2008, there are three distinctive sub-periods worth highlighting: 1993-1998, 1999-2003 and 2004-2008. I will consider each in turn.

III.A. 1993-1998: Wall Street to the Rescue

Traditional debt and equity capital suppliers to the CRE sector were crippled by the S&L crisis. Private capital sources had previously dominated both sides of the market. On the debt side, S&L's, a significant source of CRE debt capital in the 1980s, were gone forever. Commercial banks, which had supplied much of the short-term construction finance during the building boom of the 1980s, faced large losses due to the bust. Insurance companies were traditional sources of long-term mortgage loans on income-producing CRE, and they too faced large losses as default rates exceeded 30 percent for some insurers. On the equity side, outside capital often came from limited partners. But these capital sources were mostly *not* institutional. Rather, because of tax laws that allowed individuals to offset personal income with depreciation-based accounting losses, outside equity capital sources were primarily higher-earning individual investors. This critical source of capital dried up when tax laws changed in 1986 to eliminate the favorable tax treatment.

With traditional capital sources sidelined or gone forever, the entire CRE sector was severely financially distressed in early 1990s. Furthermore, opportunity and distress funds set up to swoop in with liquidity and turn-around expertise were only just forming in the early 1990s in response to the S&L crisis, and had very little early impact.

Importantly, in sharp contrast with the Global Financial Crisis (GFC) of 2007-2008, Wall Street was mostly unscathed by the S&L crisis. Smelling a big opportunity, and with nowhere else for the CRE sector to turn, Wall Street entered the fray. What emerged was a permanent and significant redirection of capital from private to public sources.

The commercial mortgage-backed securities (CMBS) market—structured by combining elements of the residential mortgage-backed security and the junk bond—emerged in 1991 as a mechanism to package and sell distressed CRE mortgage loans. It then quickly morphed into a source of permanent mortgage loan financing – known as the "conduit" CMBS market – taking the place of S&L's and some insurance companies. Figure 4 displays CMBS issuance volume from 1993 through 2008, where we note that CMBS outstanding prior to 1993 was only on the order of $10 billion. Issuance volume from 1993 through 1998 was, in contrast, nearly $200 billion, with 50% of all new

CRE mortgage originations occurring through the CMBS market. This novel source of mortgage debt capital achieved a 15-fold expansion in the market in only a five year time period.

FIGURE 4 ABOUT HERE

On the equity side, Wall Street took an existing investment vehicle off the shelf in the form of the publicly-listed equity REIT. Portfolios of privately-held distressed CRE assets with fundamentally sound physical and locational attributes were parachuted into tax-efficient REIT investment vehicles, which were then taken public. A REIT IPO boom ensued as these firms were valued well above the value of the in-place CRE assets.[16] Figure 5 displays equity capitalization of publicly-listed REITs from 1978 through 2008. This figure shows that total capitalization was about $10 billion in 1990, growing to $40 billion by 1993 and to over $150 billion by 1998. Similar to growth rates realized in the CMBS market, equity market capitalization of REITs increased by 15 times in the span of only seven or eight years.

FIGURE 5 ABOUT HERE

Where were pension funds during this 1993-98 time period? Largely on the sidelines, still shell-shocked by the aftermath of the S&L debacle and the new dynamics of capital allocation. They were, in fact, as measured by NCREIF data, net sellers of CRE during this period. Table 3 provides a comparison of net acquisition-disposition activity from 1993-998 to the earlier 1978-1992 time period. During the earlier, formative period, the number of net acquisitions increased at annual rate of 16.3%. Net acquisitions as measured in nominal dollar terms increased by 30.1% annually. In contrast, over the 6-year 1993-98 time period that coincided with the introduction of CRE public capital markets, nominal net pension fund investment actually shrunk by about 1% per year.

TABLE 3 ABOUT HERE

III.B. 1999-2003: The End of the Beginning, Growth in Alternative Investments

The 1999 – 2003 sub-period marked the "end of the beginning" for many DB pension funds. By the end of 2003, the earlier era, characterized by a "prudent man" investment approach that stressed wealth preservation over risk-taking, gave way to a new era shaped by an increasing gap between plan sponsor assets and retirement payout liabilities. Secular declines in nominal interest rates and yields on fixed-income investments combined with disappointing returns to public equities to negatively impact

[16] An underappreciated outcome of the REIT IPO boom in the US is the migration of top managerial talent from the private to public side of the market. This shift in the balance of talent persists to this day, and is an important reason why performance differences between NAREIT and NCREIF/PERE have persisted. For additional analysis on talent migration into the REIT sector, see Packer et al. (2014).

pension fund assets. This then combined with generous promises made to plan participants to create a structural underfunding problem. The underfunding problem had begun to emerge by 2003, but few fully realized it at the time.

I will provide a detailed analysis of the underfunding problem in the next sub-section. For now it is worth documenting the rise of alternative investments, which broadly coincided with the emergence of the pension underfunding problem. Alternatives are at a high level classified as liquid or illiquid. Liquid alternatives generally refer to hedge funds (HF's), while illiquid alternatives generally refer to private equity. Within PE there are several types of funds, including buyout (BO), venture capital (VC) and real assets. PERE has historically dominated the real asset category.[17]

Figure 6 displays assets under management (AUM) for HF's from 1990 to 2010. From 1999 to the end of 2003, HF AUM roughly doubled from $0.5 trillion to $1.0 trillion. Figure 7 shows the aggregated net asset values (NAV's) for non-PERE PE and Real Estate (PERE) funds from 1990 to 2019. Fund growth is seen to ramp up starting in the late 1990s.

FIGURES 6 AND 7 ABOUT HERE

A comparison of fund sizes in figures 6 and 7, together with pension fund allocations to these three categories of investment, reveals an important fact regarding pension fund investment in CRE. Taking the year 2001 as a baseline, according to the Public Plans Database (PPD) aggregate plan sponsor allocations to CRE were 4.4%, with a 3.6% allocation to PE and a .34% allocation to HF's. At the time, pension funds were the dominant investor in CRE funds, with an LP investor share estimated to be in excess of 80%.[18] In contrast, as a result of their large aggregated fund sizes along with lower allocation percentages, pension fund investment shares to PE and HF's are much smaller – 13.8% to non-PERE PE and 1.3% to HF's.[19] The implication: At 80%, the share of pension fund investment in CRE is much more meaningful than it is in non-PERE PE and HF's.

[17] With an abuse of standard terminology, from this point forward I will include open-end core CRE funds (that I have previously referred to generically as NCREIF) under the umbrella of PERE. Thus, herein, PERE is meant to encompass core to opportunistic investment strategies, and everything in between, with a focus on equity funds. PERE therefore refers to all forms of institutional (primarily pension fund) investment in private CRE equity funds.

[18] Allocations to CRE will be discussed in detail in section IV.

[19] The 13.8% non-PERE PE share derives from a 3.62% pension fund allocation to PE multiplied by $2.075 billion of pension assets reported in 2001. The resulting number is divided by the aggregated PE NAV of $543.5 billion to produce the 13.8% share. The HF share follows a similar method based on .342% pension fund allocation and $539 billion in HF AUM in 2001.

III.C. 2004-2008: The Underfunding Problem Emerges

Figure 8 displays NCREIF versus NAREIT indexed performance over the 1993 to 2010 time frame. During the 2004-08 window, NAREIT eked out a small positive annualized return of just under 1%, while NCREIF delivered robust performance of 11.75% annually.[20] The broader equity markets were not so fortunate. Figure 9 shows a long time series of the S&P500 index through 2010, with red lines demarcating the three sub-periods – 1993-98, 1998-2003, 2004-08 – considered in this section. As summarized in Table 4, annualized public equity returns are negative in both the 1998-2003 and 2004-08 sub-periods. Also reported in Table 4 are 10-year Treasury bond yields as of beginning-year 1993, 1999, 2004 and 2009, respectively, with a longer time-series of 10-year Treasury rates displayed in Figure 10 (red lines again demarcate sub-periods considered in this section). As buy-and-hold investors, in the short-run pension funds were partially protected against declining interest rates. They were, however, exposed to the declining rates as bonds matured and because retirement fund inflows exceeded outflows at the time.

FIGURE 8 ABOUT HERE

FIGURES 9 AND 10 ABOUT HERE

TABLE 4 ABOUT HERE

DB pension plan sponsors were allocating over 90 percent of their portfolios to public equities and traditional fixed-income in the early 2000s. At the same time they targeted returns of 8% to meet funding requirements. Given declining interest rates and poor equity market performance, gaps began to appear in the balance sheets of plan sponsors. These gaps – measured by the difference between pension fund assets (the market value of investment portfolio) and accumulated benefit obligations to plan participants (the present value of the forecasted liability stream) – became large enough by 2008 to begin to draw the notice of researchers. The seminal work on the topic belongs to Brown and Wilcox (2009) and Novy-Marx and Rauh (2009) (henceforth B-W and NM-R), which I will now summarize.

Focusing on public DB pension funds, both papers expose an accounting device that served to mask the underfunding problem. Pension fund liabilities are estimated as a series of actuarially determined payout obligations to plan participants based on contributions and payout formulas, expected and realized retirement timing, and life expectancy. These obligations can be forecasted with reasonable accuracy. But what are known as GASB 25 and ASOP 27 provide public plan sponsors

[20] As seen in Figure 8, the NAREIT index recovered quickly in 2009 and 2010 while NCREIF displayed its usual subdued and lagged response to changing market conditions. If returns to NCREIF/NAREIT are calculated over 2004-09 and 2004-10, we obtain 6.35%/4.99% and 7.31%/8.00% returns, respectively.

discretion to choose discount rates on the liability stream that reflect the risks of the invested assets. In particular, GASB 25 states that the discount rate "should be based on an estimated long-term investment yield for the plan, with consideration given to the nature and mix of current and expected plan investments…" (Brown and Wilcox (2009)). From 2000 to 2008, the vast majority of public DB pension funds chose a discount rate of 8.0%. Based on that discount rate the estimated value of liabilities were such that, prior to 2008, no meaningful underfunding problem appeared to exist.

B-W and NM-R argue there is no necessary connection between the risk-adjusted discount rate appropriate for the asset portfolio and the discount rate applied to value pension liabilities. This is because the liability stream – retirement payout promises made to public employees and backed by the taxing and bond issuance authority of the states or localities sponsoring these plans – more resembled riskless cash flows than risky ones.

By using discount rates that better reflect the low-risk nature of the liability streams, NM-R estimate a funding gap as of year-end 2008 at $3.23 trillion if liabilities are discounted at Treasury rates and $1.31 trillion if liabilities are discounted at taxable municipal bond rates. These estimates compare to just under $2 trillion in state-level pension assets, indicating a rather massive gap. Using the underfunding upper bound of $3.23 trillion, NM-R assign a liability of $21,500 for each and every household in the US. The authors further estimate an additional $1 trillion funding gap for local public pension plans. Finally, they go on to show that, although the funding gap grew significantly in 2008 because of the effects of the GFC, large shortfalls existed even in 2005 and 2006.

These two papers have spawned a robust literature over the last 10-plus years that has sought to refine underfunding estimates and examine more subtle incentive effects. For example, according to the World Economic Forum, across major economies the underfunding gap is forecast to be $224 trillion by 2050. Pagliari (2019) shows that the state of Illinois pension fund, as of 2018, is by itself underfunded by at least $131 billion. He further calculates that accrued pension liabilities from 2003-16 grew at three times the growth rate of state GPD. There is also research that shows that plan sponsor board composition affects investment choices, with poorer results corresponding with more politically connected board members (Andonov et al. (2017)). Importantly, research now shows that more underfunded pension funds: 1) hold riskier asset portfolios that realize lower relative returns, 2) apply higher discount rates to their liability streams and, 3) pay higher investment management fees (Franzoni and Marin (2006), Andonov et al. (2017), Aubry and Crawford (2019)).

B-W and NM-R raise several moral hazard problems that accompany GASB 25 and ASOP 27: 1) By decreasing liabilities with an artificially high discount rate, incentives for plan sponsors and

governments to address funding gaps are reduced; 2) When retirement funding shortfalls can no longer can be ignored, there are incentives for states and localities to issue "Pension Obligation Bonds" that shift underfunding costs to future generations;[21] and 3) By linking liability discount rates to the risk of the investment portfolio, incentives exist for plan sponsors to increase portfolio risk in order to apply a higher discount rate to their liabilities.[22] I note that a related but slightly different rationale for increasing investment risk is to "gamble for resurrection."[23] This gamble may not be quite as urgent for pension funds today as it is for firms on the brink of bankruptcy and potential liquidation, but the incentive exists nonetheless, suggesting a gradual shift towards higher returning (in expectation) but riskier investments as plan sponsors reach for yield.[24]

Another way to express the incentive issue is that, starting in the early 2000s, many plan sponsors found themselves beginning to live a life of quiet desperation. Quiet desperation, a symptom of addressing a pension underfunding overhang problem along with having to meet aggressive portfolio return objectives in a low-yielding investment environment, manifests itself in the distorted choices that plan sponsors make in response and the outcomes that they actually realize.

A particularly revealing choice is the plan sponsor portfolio allocation decision. In 2001, according to the Public Plans Database, pension fund allocations to alternative investments (including commodities) was 8.8%, implying that over 90% of the DB plan sponsor portfolio was allocated to traditional investment categories public equities and fixed-income (including a small percentage of cash). Fast-forward to 2008 and allocations to alternatives almost doubled to 16.9%, with 6.9% going to PERE, 6.6% to non-PERE PE, and 2.0% to HF's. Allocations to traditional investment categories had decreased to just over 83%.

Is such an allocation increase meaningful? Suppose a plan sponsor is asked to generate an 8.0% return on its portfolio over the next year. Further suppose that, based on low interest rates and market risk premia, public equities and traditional fixed income together are expected to generate a 6.0% return. A 100% allocation to those two asset classes will obviously fail to produce the required 8.0%

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[21] Novy-Marx and Rauh (2009) comment on Ricardian equivalence, emphasizing that full information is required for equivalence to obtain. They state, "without public knowledge about the extent of the pension underfunding, individuals do not know how much to set aside for their children to help them pay off this debt." [p.206]

[22] See Andonov et al. (2017) for evidence.

[23] "Gambling for Resurrection" was a term commonly used during the S&L crisis of the 1980s to describe S&L behavior when they had little or no net worth. Standard corporate finance refers to this as the "risk-shifting problem," whereby financial distress causes equityholders to instruct managers to take on risky, negative NPV projects, hoping to realize upside gains if things go better than expected and disproportionately shift the losses to bondholders if things don't.

[24] See, e.g., Rauh (2016), who states, "In order to target such returns [of 7.5-8 percent per year], [pension] systems have taken increased investment positions in the stock market and other risky asset classes such as private equity, hedge funds, and real estate." See Andonov et al. (2017) for additional detailed evidence. For evidence on incentives to reach for yield in a low inflationary and interest rate environment, see Becker and Ivashina (2015) and Choi and Kronlund (2017).

expected return, so a higher-yielding – and riskier – category of investments is required. Introduce alternatives, including PERE. Suppose alternatives are expected to produce a 16.0% return. An 8.8% allocation to alternatives (that existed in 2001) generates a 6.9% expected portfolio return. Not enough. Now increase the allocation to alternatives to 16.9% (that existed in 2008), and a 7.69% overall return is anticipated. Close, but not quite there. Go to the 20% allocation and, voilà, an 8.0% expected return is generated. The 20% allocation mark for alternative investments was, in fact, crossed in 2011.

This simple investment calculus, known as *return targeting,* accurately describes the thinking and general approach that many plan sponsors make when living a life of quiet desperation. In other words, investors that target returns put more focus on absolute performance than risk-adjusted returns, implying violations to usual assumptions underlying classical finance theory (see Gompers et al. (2016)). There is further evidence that institutional investors display loss-averse behavior – another violation of classical finance theory (Bodnaruk and Simonov (2016)). Loss averse preferences on the part of underfunded plan sponsors may have particularly deleterious effects. These plan sponsors will naturally reference their retirement liability estimate in relation to total portfolio asset value. The more underfunded the plan sponsor is, the more it "hurts" from a utility perspective, implying *risk-seeking behavior* as plan sponsors attempt to recoup pain-inducing losses caused by historical underperformance and generous retirement benefit promises.[25]

IV. 2001 – 2019: CRE Allocations and PERE Investment Performance

In the previous section I document how persistently low interest rates and market risk premia combined with generous retirement benefit promises to create a structural pension underfunding problem. The underfunding problem goes a long way in explaining increasing allocations to PERE funds, as well as other forms of alternatives, under the theory that alternatives can deliver high returns over sustained periods of time.

In this section I consider how pension fund portfolio allocations have changed over time and how PERE funds have performed since 2001. I also address related questions of whether true alpha exists with PERE fund investment, as well as pension funds' revealed preference for illiquid PERE fund investment vehicles that are apparently priced at a *premium* to liquid alternatives. Finally, I

[25] The canonical cite on loss aversion is Tversky and Kahneman (1979). For additional background, see Kahneman et al. (1991).

consider how it is that pension fund allocations continue to increase when PERE funds in aggregate consistency underperform GP-specified return targets.

IV.A. Allocations to CRE, PERE Investment Performance

Table 5 summarizes CRE allocations and PERE fund performance over the 2001 through 2019 time period. There are two sub-period groupings: 2001–2008 (pre-GFC) and 2009–2019 (post-GFC). Within each grouping public pension fund allocations to CRE are reported based on data from the Public Plans Database, or PPD, housed at Boston College. Preqin data are used to measure investment performance at the fund level. Fund IRRs are weighted by fund size and aggregated to obtain weighted means. Funds are grouped by vintage year, which is the first year that the fund reports receiving a non-zero cash flow. Only funds that invest in North America and with GP-sponsor addresses located in the US are included in my sample. Further, only funds categorized as Core, Core-plus, Value-add and Opportunistic are considered. Sample sizes are the total number of distinct funds included in a vintage year. The sample size in parentheses is the number of funds categorized as Value-add or Opportunistic. Finally, Δ-IRR measures relative investment performance. It is defined as the IRR of a fund minus the IRR of a hypothetical investment in the US FTSE-NAREIT all equity index over the exact same time frame over which the PERE fund IRR is calculated. Thus, PERE fund performance is measured relative to the public market investment alternative.

TABLE 5 ABOUT HERE

Public pension fund allocations to CRE are seen to increase steadily over the full sample period, more than doubling from 4.4% in 2001 to 9.1% in 2019. Did investment performance justify the increased allocations? During the pre-GFC sample period, the answer supplied by the Preqin data is no. Although performance is good for funds with vintage years 2001-2003, the adverse effects of the GFC severely impacted post-2003 performance on an absolute as well as a relative basis. Over the entire pre-GFC sample period, PERE funds returned only 4.3% and underperformed the public market benchmark by 3.7%. Furthermore, 308 of the 349 funds in the sample are Value-add and Opportunistic funds. These funds are advertised as higher-risk, but they also target returns in the 14 to 17 percent range on a net-of-fee basis. These funds clearly did not come close to meeting their return targets (as can be seen in Table 6).

With these less than stellar results, what happened to pension fund allocations to CRE in the post-GFC sub-sample period? They decrease somewhat in 2009 and 2010, and then resume their upward trend. This outcome may at first seem surprising given the poor showing of the 2004-2008 PERE fund vintages, but it highlights two important aspects of the PE fund business model. First,

because neither LP fund ownership interests nor the underlying assets generally trade while the fund is active, there are typically significant lags in accurately assessing fund performance.[26] These lags can create allocation persistence. Second, although the GFC hammered the performance of 2004-08 vintage funds, it also created opportunities for newly-formed funds. Market turmoil thus cuts both ways, creating a valuable hedge for GP-sponsors who highlight the future over the past when fund-raising from pension funds and other institutional investors.

Are the more recent allocation increases justified by performance in the post-GFC sample period? At first blush, the answer appears to be yes. Absolute performance to date is consistently strong, with IRRs ranging from 10.4% to 18.7% on average for all vintages in the post-GFC sample. To provide a more detailed look at PERE fund performance, Panel B of Table 6 reports absolute and relative performance for funds categorized as Core, Core-plus, Value-add and Opportunistic. Panel A of Table 6 provides working definitions for the four fund categories, ranges of GP-specified net-of-fee IRR targets and ranges of fund leverage targets. Data to establish target IRR and leverage ranges come from PREA's 2016 Management Fees and Terms Study and my own analysis of Preqin PERE fund level data. Figure 11 visually displays IRRs by fund category over the 2001 – 2019 sample period. To construct this figure I use average IRR by vintage year instead of weighted average IRR as reported in Table 6.

TABLE 6 ABOUT HERE

FIGURE 11 ABOUT HERE

Focusing on the post-GFC sample period, Table 6 indicates that investment performance is consistently strong by category on an absolute basis. Performance is also good overall relative to the NAREIT public market benchmark. But, it is mixed relative to target IRRs seen in Panel A of Table 6. Core and Core-plus performance is above target, while Value-add is at target. Opportunistic, on the other hand, is below target.

There are several reasons to question whether this more recent performance will hold up over time. First, there is likely some upward bias in reported fund IRRs. All IRRs are self-reported to Preqin by participating GP-sponsors. GP's may have incentives to bias their reported IRRs upward by cherry-picking the best performing LPs from within a fund.[27]

[26] There is in fact limited liquidity in closed-end fund LP shares, but there are no secondary market pricing indices with which to benchmark fund performance. It is generally known that LP shares will typically sell at substantial discounts to current fund NAV, in the range of 10-25%. See "Secondaries Gather Strength to Navigate the Crisis," *Private Equity International,* June 17, 2020, www.prviateequityinternational.com/. Fund of funds are known to purchase LP interests. The GP may also make a market for the shares in order to retain control over the identity of the LP interestholder.

[27] LP performance can vary within a fund because of differences in fees or how distributions are calculated.

Second, there is a well-known upward bias in self-reported NAV's of non-liquidated funds, which generally declines over time as funds get closer to liquidation. This bias is enhanced by the fact that high performing funds generally liquidate sooner than mediocre or poorly performing funds. Approximately 10 percent of funds (48 out of 494) in the post-GFC sub-sample period liquidated by year-end 2019, with a 22.8% weighted average IRR versus 13.7% to date for non-liquidated funds. As time goes on, as the currently active funds liquidate and NAV's decline, average performance should trend lower.

Third and most important is that we have another crisis on our hands – the COVID-19 pandemic. The ultimate economic impact of this epidsode on PERE performance will undoubtedly be severe. The most vulnerable funds in our sample are clearly those that are not yet liquidated and with vintage dates of 2009 or later. Value-add and Opportunity funds are particularly vulnerable given their risky operating and financial leverage characteristics. Importantly, 382 out of the 494 funds in our post-GFC sub-period sample are non-liquidated and classified as Value-add or Opportunistic.

IV.B. Does PERE Fund Alpha Exist? Positive and Normative Perspectives

What does other research have to say about PERE investment performance? Using a combination of Burgiss, Cambridge Associates and NCREIF data over a sample period covering 2000–2017, Bollinger and Pagliari (2019) measure PERE fund performance under a classical mean-variance framework.[28] They find that Value-add and Opportunity funds underperform by about 3% per year on a risk-adjusted basis.

Gupta and Van Nieuwerburgh (2019) use Preqin data covering the same 2000–2017 sample period to empirically analyze PE fund performance using a cash flow-based asset pricing approach. To do so, they match PE fund cash flow strips with cash flow strips implied by available bonds and publicly listed equity securities over matching time horizons. This generates a replicating portfolio of publicly available securities with which to assess PERE fund (as well as other PE fund) returns. After considering a large set of possible pricing factors, they find that PERE fund strip returns load primarily on returns to REIT dividends and capital gains. For every $1 of capital committed to PERE, they find the LP loses 17 cents on the dollar on average on a present value risk-adjusted basis. Given an average fund duration of five to seven years, underperformance is on the order to 3-4% per year.

[28] Pagliari (2020) is a companion paper published after the 2019 paper, but written prior to the 2019 paper. Its sample period ends in 2012, with findings that are generally consistent with the 2019 paper.

Riddiough and Wiley (2020) use both Preqin and Burgiss data to analyze fund performance based on the public market equivalent (PME) measure developed by Kaplan and Schoar (2005).[29] Over their 1992 – 2016 sample period they find an average PME of 1.0 using Preqin data (indicating break-even performance) and 0.93 using Burgiss data (indicating underperformance of between 1.5% to 2.0% per year).[30] Based on vintage year results reported in their paper, and mapping these results into the same 2001-08 and 2009-17 sub-sample periods used in this study, their findings indicate PME's of 0.79/0.78 to Preqin/Burgiss over the pre-GFC sample period (indicating underperformance of 3-4% per year) and 1.09/1.06 to Preqin/Burgiss over the post-GFC sample period (indicating outperformance of 2-3% per year).

Thus, in summary, Bollinger and Pagliari (2019) and Gupta and Van Nieuwarburgh (2019) find inferior risk-adjusted performance of 3-4% per year. My results along with those of Riddiough and Wiley (2020) indicate significant underperformance for vintages 2001 through 2008, with much-improved performance for 2009 and later vintages. But, as discussed, more recent vintage performance is very much up in the air with the aftershocks anticipated from COVID-19.

In general, I am skeptical that, across the sector as a whole, PERE funds are capable of generating positive alpha. To do so, PERE GP-sponsors would have to have access to capital and/or possess skills in buying, selling, owning, operating and developing CRE that don't exist and are not replicable in other parts of the CRE market. Are there other investors such as REITs or private non-PERE enterprises that can do what, say, Blackstone does with CRE? I believe the answer is yes, certainly with respect to income-producing assets. I believe this to be true even with very large-scale transactions. Some may argue that REITs are not well-suited to do development. But neither are large PERE sponsors, as real estate development generally requires a strong local presence to identify and successfully execute on opportunities. Can REITs manage CRE assets more cheaply than PERE fund sponsors? The answer again seems to be yes, as REIT fees in the form of G&A expenses average less than 1.0% of equity value. In comparison, PERE fees meet or exceed 1.5% for Core/Core-plus, and are 3% for Value-Add and 4% for Opportunistic funds.

Even though PERE performance may be questionable across the sector as a whole, it could be that certain GP's deliver persistently strong performance while other GP's generate persistently mediocre or poor returns for their investors. In recent work with Da Li (Li and Riddiough (2020)), I

[29] PME is defined as the PV of net-of-fee LP cash inflows divided by the PV of net-of-fee cash outflows. Discount rates are time-varying realized returns to an appropriate benchmark index over the relevant fund holding period.
[30] Riddiough and Wiley (2020) use the all equity FTSE-NAREIT index as the benchmark index. They also use LP cash flow data to calculate PME's, whereas in this study I use IRRs provided by GP's to Preqin.

address this question, focusing on fully liquidated PERE value-add and opportunity funds. In doing so, Li and I analyze Preqin data and apply the method of Korteweg and Sorensen (2017) to distinguish between noise, true long-term persistence and overlapping fund effects. We do find evidence of long-term persistence in investment performance, but also that it is hard to act on performance information in real time because it takes many years before GP outperformance can be pinned on skill rather than luck. We also find the better and more persistently performing GPs tend to be smaller and have fewer funds. In contrast, brand name GPs that offer multiple, large funds such as Blackstone, AEW and Carlyle generate mediocre performance of 10.4%, 10.3% and 9.1%, respectively. This places all three GP's in the third quartile of performance, ranked #111, #113 and #123, respectively, out of 200 GP's in our sample. The only GP with five or more funds to place in the first quartile of performance is Waterton, with eight funds and a 21.1% average return (ranked #37). But its average fund size is only about $1/10^{th}$ that of the previously identified GP's. All of this implies that, although alpha may exist with certain GPs, it is hard to act on. Moreover, scale seems to be the enemy of alpha.

Cochrane (2011) in his AFA presidential speech famously stated that there is no alpha, just beta we understand and beta that we don't understand. This may be true in theory, but can be more difficult to prove in practice. Gupta and Van Nieuwerburgh (2019) in their study of PE fund performance recognize that it may be difficult for investors to replicate complex factor strategies on their own, implying they may be willing to pay managers to do it for them. This seems to be true in the cases of BO and VC funds, not to mention HF's. But those complexities don't exist with public market alternatives to PERE funds, as Gupta and Van Nieuwerburgh (2019) show and I argue herein. All of this causes me to conclude that alpha does not, and, more importantly, really cannot exist across the PERE industry as a whole.

IV.C. The Illiquidity Price Premium

Standard economic reasoning suggests that investors should discount the acquisition price of assets that are less liquid than otherwise equivalent assets (see, among many others, Brunnermeier and Pedersen (2009)). This price discount maps into an illiquidity premium in the risk-adjusted rate of return required on investment. Consequently, standard reasoning would suggest that holding CRE in a REIT investment vehicle, whose equity ownership shares are generally quite liquid, should require lower returns than otherwise equivalent CRE held in an illiquid closed-end PERE fund vehicle.[31]

[31] Some have argued that part of the illiquidity premium paid by LPs is actually a control premium, whereby the large LP fund investors (often pension funds) can influence initial fund structure and fees, as well as have input on certain operating

Comparisons of NCRIEF versus NAREIT investment performance indicates the opposite in fact seems to hold. Figure 12 graphs the NCREIF v. NAREIT indices over the full 1978 to 2019 time frame covered in this paper. NCREIF generates a 9.13% average annual return, whereas NAREIT produces a 12.45% annual return. This is more than a 3% return differential realized over a 42-year time period.[32] To put this difference in perspective, as seen in the figure a pension fund that held the NAREIT index over this time period would be more than 3-times better off than a pension fund that held the NCREIF index.[33]

FIGURE 12 ABOUT HERE

Berk and Green (2004) provide an internally consistent framework that predicts fund investors will earn zero alpha after fees. This happens because fund managers internalize any surplus they create so as to make investors indifferent to the public market alternative. Applying this logic, the greater than 3% differential we identify can be attributed to illiquidity, but not in the expected direction. In other words, pension funds, which are by far the largest single class of investors in PERE, seem to have revealed a strong preference for *illiquidity* in CRE investment relative to liquid alternatives. At a rate that may exceed 3% per year, this is a remarkable relationship, particularly considering that Franzoni et al. (2012) and Sorensen et al. (2014) estimate a diametrically opposite 3% illiquidity risk premia required on PE investment. This represents a 6% return differential *per annum*!

I am not the first to comment on this unusual relationship. Gupta and Van Nieuwerburgh (2019) state that:

> To the best of our knowledge there is no hard evidence of the existence of an illiquidity premium [included in the discount rate]. Many institutional investors such as pension funds value the fact that PE investments do not have to be marked to market. Given that public pensions make up the largest asset allocator to PE, then the illiquidity premium could in fact be negative.

Asness (2019) in his discussion of a possible illiquidity rate discount in PE fund investment makes the following observations:

> … pricing opacity may actually be a feature [of PE fund investment] not a bug. Liquid, accurately priced investments let you know precisely how volatile they are and they smack you in the face with

decisions when the fund is active. It is an open empirical question whether control is real and whether it generates tangible benefits for the LP investor.

[32] Again, some readers may object to my presumption that risks are equivalent between the two indices. I stand by my earlier commentary, noting further that NCREIF is reported gross of fees while NAREIT is net of fees. Moreover, although there are compositional differences in the two indices, recent events have revealed significant geographical concentration risks embedded in the core-based NCREIF index. Which category of investment is, for example, riskier in light of COVID-19 – retail malls and office located in NYC or cell towers and data centers?

[33] That said, one must be cognizant that 42 years of quarterly observations does not, statistically speaking, generate a whole lot of power. Even a century's worth of higher frequency stock return data cannot definitively indicate whether there is a positive relation between risk and return – see Lundblad (2007).

> it… What if illiquid, very infrequently and inaccurately priced investments made them better investors as essentially it allows them to ignore such investments given low measured volatility and very modest paper drawdowns?... So, I think its entirely possible that investors are accepting a discounted expected net return…for the privilege of not being told prices.

Green Street Advisors, a highly respected independent CRE industry and REIT analyst, is more circumspect:

> The excuse given [by pension funds] for avoiding listed REITs is their high volatility…Claims that the public [investment vehicle] wrapper somehow changes the nature of a property portfolio's investment merits are not only non-sensical – they're demonstrably false. ("If It Looks Like a Duck…," 12/20/2018)

The price premium paid by pension funds for PERE fund investment thus seems to originate from inhibiting the observation of return volatility. But the low measured return volatility of NCREIF (7.3% v. 16.4% for NAREIT over the entire 1978-2019 time period) and the low contemporaneous cross-correlation of NCREIF with NAREIT (.12 over the same time period, which increases to .61 if NAREIT returns are lagged one year) are simply an artifact of appraisal smoothing – nothing more. Pension funds are in essence paying for a veil – the PERE fund vehicle wrapper – that adds noise into the price discovery process.

One could argue that the PERE fund price premium derives from a more complex set of investor preferences and behavioral attitudes, with differences in liquidity playing no central role in explaining underperformance. For example, it may be that, when it comes to investing in alternatives such as PE and PERE, pension funds engage in a form of Thaler-like mental accounting that reveals risk neutral or even possibly risk seeking investment behavior resulting from underfunding problems and return targeting (see, e.g., Thaler (1999)). PERE funds thus overpay as a result of lower risk aversion relative to public-equity REITs whose cost of capital reflects a broad-based market risk premium. I am not unsympathetic with that view.

The essential problem remains, however, which is that pension funds pay higher prices for otherwise identical assets in comparison to prices paid by publicly listed firms. As a result, because of the existence of parallel asset markets for commercial real estate, pension funds seem destined to experience the gambler's ruin problem whereby the house has a betting advantage over the gambler, and always eventually wins with the gambler losing everything. But it is actually worse than that. Systematic shocks occur, as they did in the GFC and as they are now with the pandemic. In these cases low payoffs to pension fund investment occur precisely when the marginal utility to consumption is high. It's a terrible thing to bankrupt a vital source of retirement income, but it's even worse to

bankrupt that source of income at a time when retirees and taxpayers (who will have to fund a bailout) can least afford it.

IV.C. Lake Wobegon Benchmarking of the Marvelous Kind

Value-add and opportunity funds attract more than 70% of total funds raised in PERE. As seen in panel A of Table 6, fund sponsors target returns for their investors of between 13.5% and 17.5%. Yet, as seen in panel B of the table, performance has been at- or below-target. Bollinger and Pagliari (2019) and Gupta and Van Nieuwerburgh (2019) provide evidence of 3-4% underperformance on a risk-adjusted basis. Given that GPs regularly miss hitting promised return targets, with poor risk-adjusted returns as documented in recent academic studies, how is it that pension funds continue to allocate to value-add and opportunity PERE funds? One might expect this kind of performance to discourage rather than encourage fund flows.

An important piece of evidence that helps explain this is internal pension fund benchmarking set up to show above-average performance when in fact performance is at or below the GP's target and other external risk-adjusted benchmarks. Based on 2015 data I obtained from Hewitt-EnnisKnupp, of the 30 largest public pension funds in the US, 20 benchmark directly to the NCREIF or equivalent fund with no adjustment, eight add a premium above the NCREIF index of between 50 and 200 basis points, and two actually subtract 25-130 basis points from the NCREIF index. Separately, MacKinnon (2019) surveyed 29 US-based institutional investors (presumably pension funds). Here the use of unadjusted NCREIF as a benchmark is about 50%. An eye-opening statistic is that out of 16 investors that identify themselves as deploying value-add and/or opportunistic strategies, only four, or 25%, add a premium to the NCREIF index when benchmarking. Most investors simply benchmark off the unadjusted NCREIF index, which generates a 9% return on average. This is 4.5% to 8.5% below GP-advertised target returns to value-add and opportunity funds, and 3% below NAREIT's long-run average return.

My own review of PPD data, which incorporates a much broader cross-section of public pension funds, shows more variation in the chosen internal index benchmark. For example, CPI plus a spread of 3-4% is often seen as a benchmark in the PPD data. But CPI plus 4% or even 5% will, for the last several decades, produce a benchmark that is generally *below* NCREIF. Neither the Hewitt Ennis/Knupp data nor MacKinnon (2019) indicate whether a NCREIF benchmark is gross or net of fees. The PPD data show that some pension funds are explicit about netting out fees. I suspect that practice is skewed towards a net-of-fee benchmark, creating an even larger gap between GP target returns and internal benchmarks. Interestingly, the PPD data also indicate that pension funds' own

internal return targets. For example, it is not unusual to see return targets in the range of 10% for real estate portfolios that contain a significant proportion of value-add and opportunity fund investments. Thus, it appears to be common practice for public pension funds to take GP-return targets and mark them down internally to bring them more in line with expected returns from the utilized internal benchmark.

Benchmarking to unadjusted NCREIF may not be inappropriate for pension fund portfolios that contain only core investment, but it certainly seems inappropriate for riskier PERE portfolios. Perhaps this is simply another example of how "quietly desperate" pension funds behave in risk-neutral or even risk-loving ways, treating their allocations to PERE and other alternatives as "house money", with Thaler-like mental accounting at work. A less generous view of benchmarking of this kind is that it is delusional and self-serving, with potentially serious long-run consequences.

V. Concluding Remarks: Do Pension Funds Pose Risks to Economic and Financial Stability

V.A. Some General Observations

From a classical financial economics perspective, plan sponsors exhibit pathological investment behaviors. They herd, making it harder for them to exploit truly valuable investment platforms; they display loss aversion, seeking out riskier investment opportunities to mitigate the "pain" associated with underfunding; they focus on absolute returns (IRR) rather than evaluating investment on a risk-adjusted net present value basis; they seem indifferent to whether targeted returns are due to alpha or beta; they show aversion to having to observe asset price volatility; they engage in delusional benchmarking, giving themselves A's and B's for C and D work. All of these behaviors seem to be influenced by agency concerns and conflicts.

A few more words about alpha v. beta. The distinction between the two is crucially important, with huge macro and political economy implications. Alpha in PE is about earning extra-normal returns, typically as a result of superior GP skill. Alpha is not a priced risk of investment; rather, for an LP, it is about hooking up with a GP that is skillful at locating and creating value when nobody else can, and who then shares some of the gains with the LP. Evidence suggests, however, that true alpha in PERE fund investment is very hard to find.[34] In fact, based on their realized relative investment

[34] In ongoing work with Da Li, I am finding no evidence that PERE LPs exhibit investment persistence of their own by systematically matching with high-performing GPs.

performance over the last 20-plus years, pension funds seem content to underperform on the order of 3-4% per year on average.

Without alpha, the only thing left to help meet aggressive return targets is beta. And beta is about systematic risk. Although pension funds may not seem to care about the distinction between alpha and beta, society should. Why? Pension funds are a big and important investor category, particularly in PE and especially in PERE. They are capable of and in fact do move CRE markets (Ghent 2020). If pension funds systematically take large risks when trying to hit high portfolio return targets, some underfunded pension funds will fail.[35] Perhaps many will fail, and they may all fail at the same time.

It has been well established that underfunded pension funds pose a threat to local economic stability (see, e.g, Pagliari (2019) for a detailed analysis of Illinois and the city of Chicago). With data through 2018, a recently released study by the Pew Charitable Trust documents the broader risk across all fifty states. Figure 13 (based on Figure 1 of that study) shows the increasing public pension liability funding gap, which is conservatively estimated at just under $2 trillion. On average across all states, public pension liabilities are only 71% funded, having returned only 5.2% on average for the past 20 years (according to Wilshire Trust data). Figure 14 (based on Figure 2 of that study) shows funding levels across states. New Jersey and Illinoi are less than 40% funded, two other states are less than 50% funded, and there are nine states overall that are less than 60% funded.

FIGURES 13 AND 14 ABOUT HERE

Should public pension funds become bankrupt, they will certainly seek and will inevitably obtain government bailouts. Bailouts will create big local economic problems, as costs will be borne by taxpayers and perhaps retirees who vote in elections. But are pension funds a systemic risk as well – a threat to financial stability? Many would answer no, as pension funds do not generally use their own leverage to purchase stocks, fixed-income and alternative investments.[36] But stocks themselves are levered, as are (especially) PE and HF's. To the extent this leverage contributes to financial system

[35] An often overlooked fact about reaching for return by taking greater risk is that it can be self-defeating due to the standard convexity correction involved when converting arithmetic returns to geometric returns. For example, take two assets that are identical in value at 100 but differ in risk. One asset's standard deviation of return is 10 percent and the other is 30 percent. A one standard deviation increase and then decrease in return to the first asset over two periods results in an asset valued 99, resulting in a one percent decline in value (and a 0 percent arithmetic return). The other asset experiences the same one standard deviation increase and then decrease in return over two periods. It is worth 91, experiencing a 9 percent reduction in value (and a 0 percent arithmetic return). The general formula for the convexity correction with normally distributed returns is $r_{Geometric} = r_{Arithmetic} - \sigma^2/2$.

[36] This is not entirely true. Pension funds have been known to use leverage tactically in an attempt to enhance returns. In June 2020, CALPERS announced it would begin to use leverage much more systematically, at about 20 percent of assets on average, stating "There is no alternative." (see "Calpers CIO Eyes More Private Equity, Leverage to Hit Target," and "For Calpers CIO, Revolution is Now," *Pensions and Investment*).

risks, the concern is whether pension funds are enabling or even encouraging the firms and funds they invest in to deploy excessive amounts of debt.

A big concern in this area is that we don't know enough about the interconnectedness of pension funds in the financial system (at least I don't). For example, it is estimated that shadow banks now originate more than 50% of residential mortgage loans in the US (Buchak et al. (2018)), and that they have made major inroads on the commercial lending side. Many shadow banks are privately owned. For example, Burgiss data indicate that PE debt funds alone are valued in excess of $800 billion as of year-end 2019, growing by eleven times since year-end 2005. Pension funds and other institutional investors own those debt funds because they provide almost all of the funds' equity capital. Are debt PE funds making loans to equity PE funds to finance their activities? If so, it sounds like a problem to me.[37]

Consider specifically the following "circle of life" that currently exists in the world of PERE. As described previously in Table 6, Value-add and Opportunity PERE funds invest in projects that often require significant renovation or ground-up development. These are very risky projects, and as we know, pension funds are the largest investor class in these funds. These funds are often financed, as advertised in their offering documents, with mortgage debt or development loans at 50 to 75 percent loan to value or cost. Where do these PERE funds obtain their financing? In recent years it has come primarily from mortgage REITs (which are also a type of shadow bank). These mortgage REITs then place these risky mortgage/development loans into Collateralized Loan Obligations (CLO's), and sell tranches to outside investors (more shadow banking).

Who purchases those tranches? Debt PERE funds are reportedly major investors in CRE-CLO's. Who owns those debt PERE funds? Pension funds and other institutional investors. Do the very same LP's that invest in the Value-add or Opportunity PERE funds (that own the CRE asset) also own the debt PERE funds (that purchase the CLO's issued by the mortgage REITs) that debt finance the CRE owned by the Value-add or Opportunity funds? In other words, are pension funds, possibly the very same pension funds, lending to themselves when they invest in both PERE debt and PERE equity funds? I don't yet know, but from a systemic financial risk perspective it would be good to find out.

[37] See also Pagliari (2017).

V.B. Concentration Risks

Pension fund concentration risks may serve to increase risks of economic and financial instability. Herding instincts among plan sponsors is the primary cause of concentration risk, which takes on several different forms.

One manifestation of herding-based concentration risk is a preference to invest with larger, more reputable GP-sponsors. Blackstone is the behemoth and gold standard in the PE and especially the PERE fund world. Table 7 shows the top 10 PERE fundraisers over the past five years. Blackstone has raised approximately $65 billion in capital, more than double second-place Brookfield Asset Management. Blackstone and Brookfield together have nearly a 20% market share, with the top 10 firms showing a 40 percent market share. According to *Fortune* and other sources, Blackstone and Brookfield are the largest publicly traded CRE firms in the world.

TABLE 7 ABOUT HERE

Expect increasing GP concentration as a result of pandemic. This happened after the GFC, with greater uncertainty causing capital to flow to the more reputable brand name firms. In the first half of 2020 alone, Blackstone raised $11.0 billion in PERE capital, three times as much as the second place firm. Without question, given its scope which extends well beyond PERE into various forms of PE, Blackstone is a large, systemically important financial intermediary.

A concentration perspective begs the next question of how much investment in PERE originates from pension funds. Earlier I did back-of-the-envelope calculations showing that, as of 2001, pension funds had a significantly greater share of total PERE investment than they did in non-PERE PE and HF investment. How have pension fund investment shares in PERE evolved in more recent years, and has ownership concentration remained high?

In Table 8, I combine data from several sources to provide estimates of the US share of pension fund investment in PERE, non-PERE PE and HF's for years 2005 through 2019. PPD data are used to provide total public pension assets by year (PPD Assets) and percentage allocations to PERE, non-PERE PE and HF's, respectively (PERE All, PE All, HF All). Burgiss data are used to generate annual aggregated fund capitalization for PERE and non-PERE PE (PERE NAV, PE NAV), while HFR data are used to generate HF assets under management by year (HF AUM). To obtain investment shares for PERE, PE and HF's, respectively, I multiply total public plan assets in a given year by the respective allocation percentage to obtain total investment by category. This number is then divided by the respective NAV or AUM for that year to obtain the share percentage (PERE Share, PE Share, HF Share).

TABLE 8 ABOUT HERE

These percentages (shaded in grey) indicate substantial pension fund investor shares in PERE since 2009, generally in the 40% to low 50% range. Pension fund investor shares in non-PERE PE and HF's are, in contrast, much lower. They are consistently in the 10% range for non-PERE PE while the HF shares are seen to increase over the past 15 years to the point where they now exceed 8%. These data therefore indicate substantial concentration of pension fund investment in PERE. At the same time there is increasing concentration of GP-sponsors within PERE.[38]

With these significant pension fund investor share estimates in mind, I turn to yet another type of concentration risk: Geographical. Where do Blackstone and the other major PERE fund sponsors like to focus their CRE investments? Core funds have typically focused on gateway "superstar" city markets – i.e., the largest most densely populated markets in the world, which also often serve as financial hubs – with increasing focus in those same markets coming from riskier fund types. Why the interest? These markets are touted as low-risk due to their diversified economic bases, their educated workforce that is well positioned to compete in an evolving global marketplace, and because of their enhanced liquidity at the asset level.

How concentrated is institutional investment in the largest CRE asset markets in the world and US? Data from LaSalle Investment Management (2018) provide some estimates. In panel A of Table 9 the Top-10 global CRE markets are listed together with institutional investor ownership share. The Top-10 US markets are displayed in panel B. Three columns are shown: i) Total CRE available for investment; ii) Total CRE that is institutionally owned; and iii) The percentage of total CRE available for investment that is owned by institutional investors. Office, retail and warehouse property are considered. Institutional owner-investors include pension funds, endowments, sovereign wealth funds, insurance companies and listed REITs. Breakdowns of individual institutional investor-owner categories are not available.

TABLE 9 ABOUT HERE

The ownership concentrations seen in the tables are significant. As seen in panel A, Tokyo, which has the largest dollar amount of available CRE in the world, is two-thirds institutionally owned.

[38] There is measurement error in calculating these share percentages. The dollar allocations into alternative investment categories derive from US-based DB public pension plans only. There are other types of DB pension plans, such as corporate, as well as non-US DB pension plans that invest in CRE in the US. Thus the numerator in our investor share calculation is biased towards the low side. On the other hand, the Burgiss and HHF data used to calculate the denominator in the investor share percentage do not contain the universe of all fund activity. They contain only activity associated with funds that contribute data to Burgiss and HHF. This biases the share percentage upwards. Finally, Burgiss and HHF data are for global funds, not just US funds, which biases fund sizes upward and the share percentage downward.

London comes in at 75% and Hong Kong at 70%. Only Seoul and Shanghai have less than 40% institutional ownership. Institutional ownership percentages for Top-10 US cities vary between 40% and 70%, with Washington DC showing the highest concentration of institutional ownership.

Ghent (2020) documents "delegated investor" shares that are disproportionately concentrated in the Top-10 US markets. By combining her estimates with my previous estimates of pension fund investment shares in PERE funds, a back-of-the-envelope calculation indicates total pension fund investor shares in CRE in the Top-10 US markets to be in the 20% range. The only other investor category that rivals this ownership concentration is publicly-listed REITs, which have investor shares of 10% to 20% in the larger markets (see Ghent (2020)).

As highlighted by Green Street Advisors ("Risky Misperceptions," 7/1618, "If It Looks Like a Duck," 12/20/18, "Calculated Risk," 1/10/19), CRE located in Top-10 US cities have lower cap rates (higher transaction prices) and higher betas (price co-movement with the broader economy) than cities outside the Top-10. Green Street further argues that the cap rate-beta relation is due to risk-misperceptions of institutional investors. Interestingly, Ghent (2020) documents the same low cap rate phenomenon in Top-10 cities, implying that delegated investors move CRE prices in major markets, but argues that there are compensating liquidity benefits as measured by increased CRE asset transaction volumes.

My previous analysis indicated that pension funds do not value liquidity in the PERE fund vehicles they invest in. As LPs, why would they value liquidity in the CRE assets owned by the PERE funds they invest in and not in the funds themselves? It may be because asset-level liquidity provides fund sponsors the necessary (anticipated) flexibility to sell assets and close out funds early (or even on time) when market conditions warrant it. In support of this conjecture, Ghent (2020) finds that CRE assets owned by delegated investors have shorter ownership hold periods than assets held by other investor types.

Ling et al. (2020) present early evidence that, over a sample period spanning January 21 through April 15 2020, as measured by REIT share prices CRE properties located in densely populated gateway-superstar cities in the US have experienced disproportionally larger negative price drops. In another series of recent articles, Green Street Advisors highlight negative price and liquidity effects that have followed from the COVID-19 pandemic (e.g., "Unrequited Love," 7/14/20 and "Urban Flight," 8/19/20). High taxes and strict regulation, together with increases in crime and remote work in large urban markets, are combining to change the conventional wisdom about gateway markets. In

particular, the COVID-19 shock seems to be revealing risks that heretofore have been neglected or misperceived by institutional investors blinded by their strong herding instincts.

In summary, there are several layers of risks associated with the concentrated levels of pension fund ownership in CRE. They include: i) GP-Sponsor concentration risks, with increasingly concentrated fundraising in PERE by a handful GP-sponsors; ii) LP concentration risks, with high LP ownership shares in PERE by pension funds; and iii) Geographical concentration risks, with high ownership of CRE assets by pension funds in the largest cities in the US and across the globe. Given the sheer quantity of pension assets, estimated at more than $40 trillion globally, and given implicit leverage baked into their increasingly prominent alternative investment platforms, and given the underfunded pension problems that are forecasted to grow exponentially, it seems hard not to conclude that pension funds pose some significant risks to economic and financial stability.

V.C. Will the Pension Fund-Real Estate Marriage Last?

One might summarize this article as documenting a shotgun marriage between pension funds and real estate that looked good on paper and seemed ripe with possibilities. But soon after there were bumps in the road and then a mid-life crisis of sorts. After that, things became a bit dysfunctional. But will the marriage end in divorce? Unlikely, unless regulators intervene, deciding that in the interests of everyone involved that one of the partners (pension funds) requires protection from the other.

The truth is that there is a strong codependency between pension funds and CRE that will be hard to break, suggesting that the marriage will continue.[39] CRE without pension fund capital would be disruptive, particularly in larger gateway-superstar city markets. REITs could, however, and probably would, step in and pick up a lot of the ownership slack in the US. Pension funds without the PERE investment alternative would be less disruptive, as there is no shortage of investment opportunities – traditional or alternative – available to investors. But if PERE was to disappear as an investment option for (public) pension funds, expect significant increases in allocations to private equity and hedge funds.

The wildcard of course is what will happen as a result of the COVID-19 pandemic. Pension underfunding problems will, almost without question, get worse. PERE and PE funds more broadly have already taken some significant write-downs, with new capital committed to PERE stagnating at

[39] In a Lehman Brothers report written 30 years ago in 1990, David Shulman recognized this co-dependency, stating: "Favoring this [appraisal as a means to maintain the 'illusion of value'] approach is the "iron triangle" of investment managers, plan sponsor staff and consultants, each of whom has a vested interest in keeping reported values high. Simply put, the investment manager sold the deal, the plan sponsor staff bought it and the consultant blessed it."

the moment.[40] As it did in response to the GFC, the Fed is operating as a giant hedge fund. These operations may be valuable for society, but they reduce opportunity for hedge funds and private equity to exploit market imbalances. Structural changes to the global and US economies are already well underway. CRE will look and act differently by the time we come out the other side of this crisis. It will be particularly interesting to see how the large densely populated gateway-superstar cities evolve, and how PERE funds perform in response.

[40] According to Preqin, PERE fundraising through H1 2020 is just over 25% of the 2019 year total.

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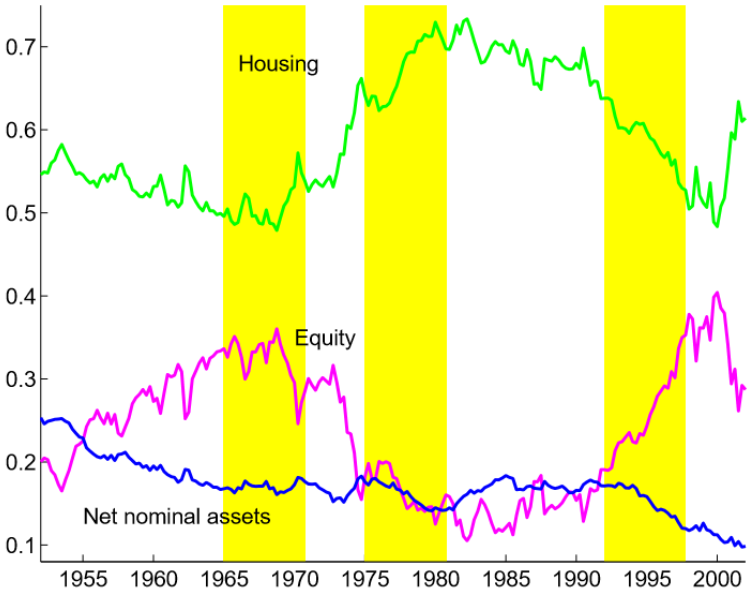
Figure 1

Share of Real Estate Relative to the Stock Market

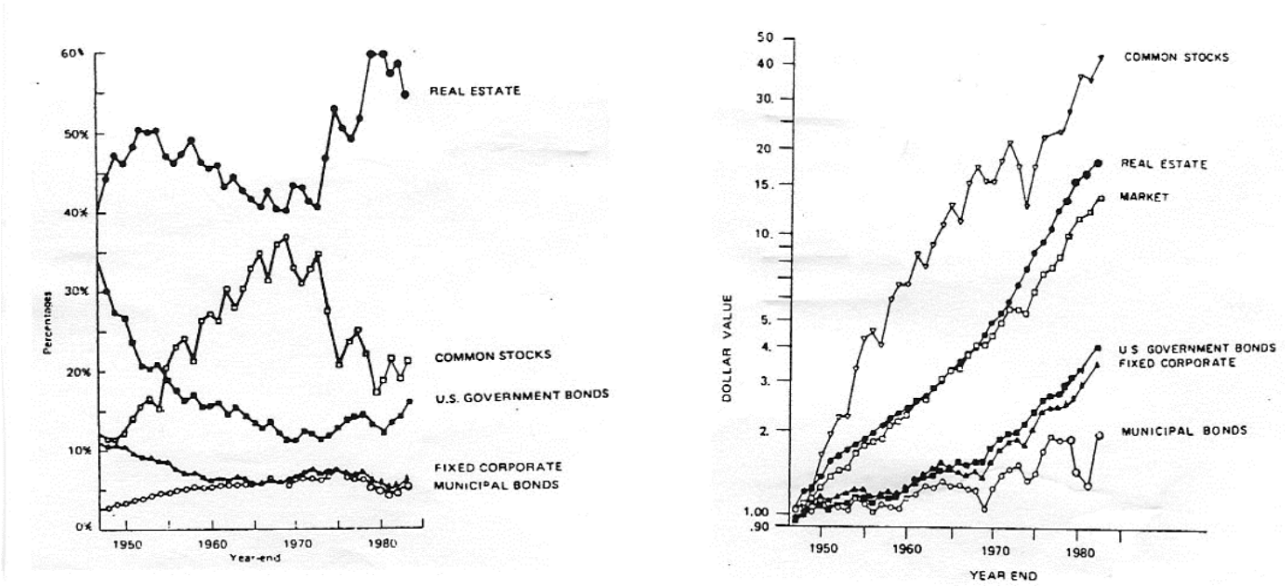


Notes: This graph is taken directly from Leombroni et al. (2020), Figure 1. Shares are aggregated wealth components divided by GDP, where the wealth components come from the Financial Accounts of the US and the authors own computations.

Figure 2

Ibbotson and Siegel (1984) Study

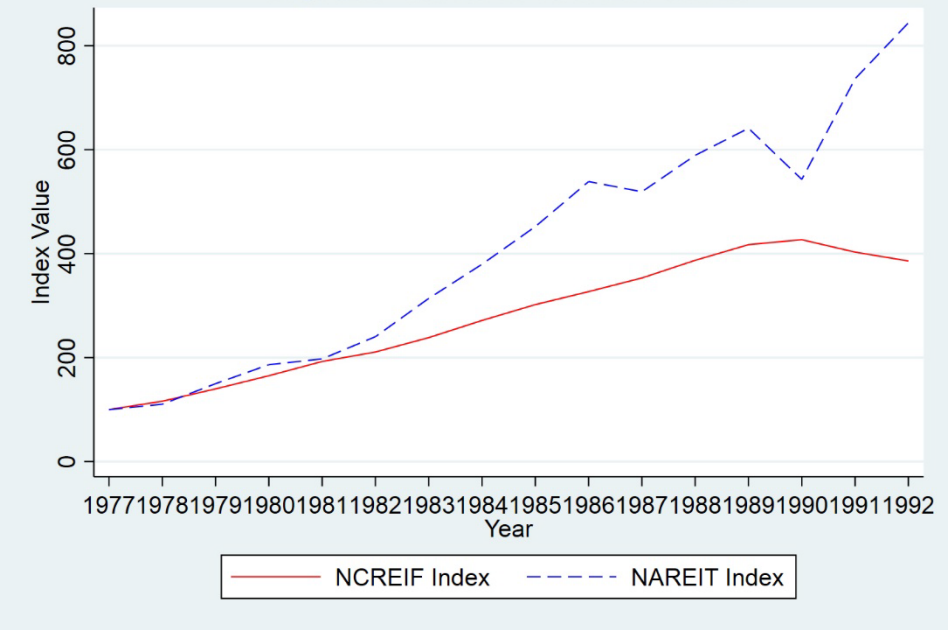
Panel A: Share of CRE **Panel B: Cumulative Returns**



Notes: Panel A and B correspond to figures 1 and 2 from Ibbotson and Siegel (1984). The real estate data come from a self-constructed index that includes residential, commercial and farm property.

Figure 3

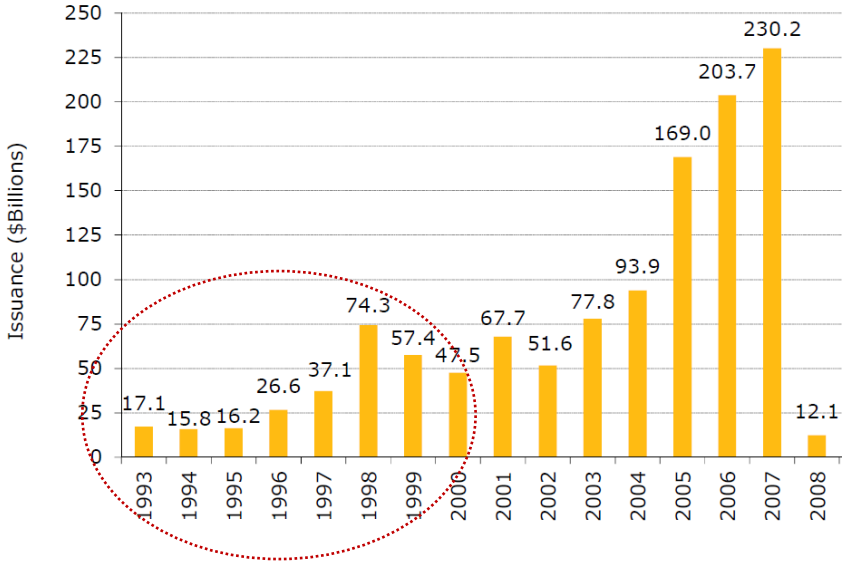
NCREIF v. NAREIT Index: 1978-1992



Notes: Index values for NCREIF and NAREIT from the inception of NCREIF in 1978. NCREIF data are obtained via membership access to their website, ncreif.org/. NAREIT data are from reit.com/.

Figure 4

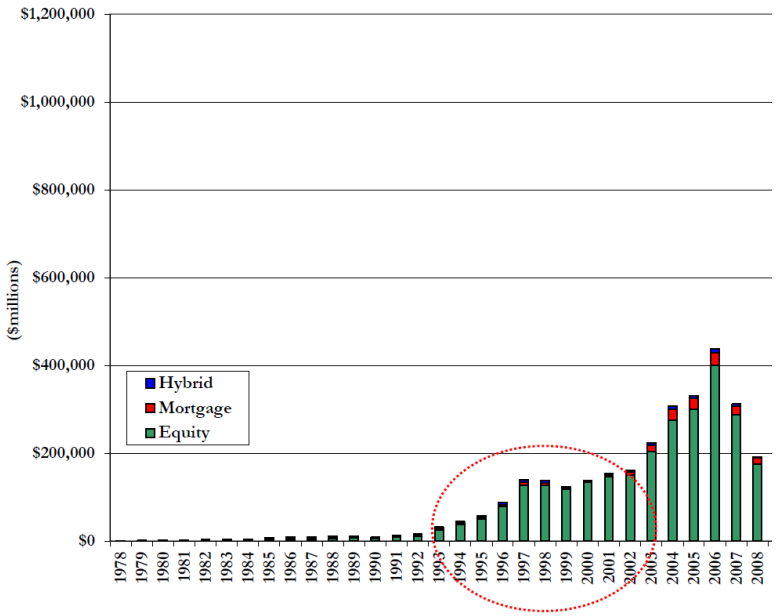
CMBS Issuance Volume: 1993-2008



Notes: Morgan Stanley CRE market research.

Figure 5

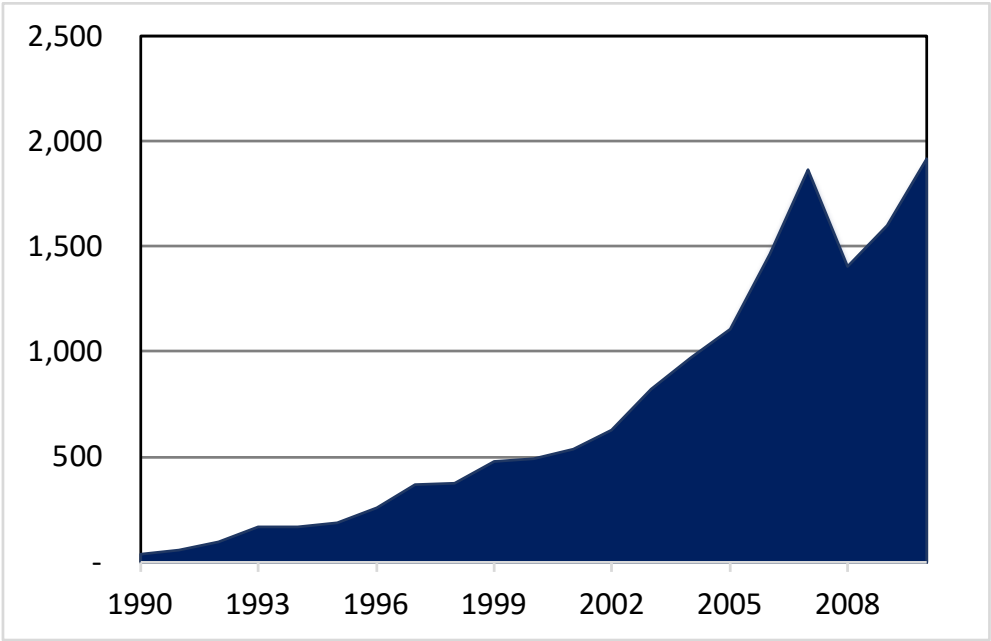
REIT Market Equity Capitalization



Notes: Morgan Stanley CRE market research

Figure 6

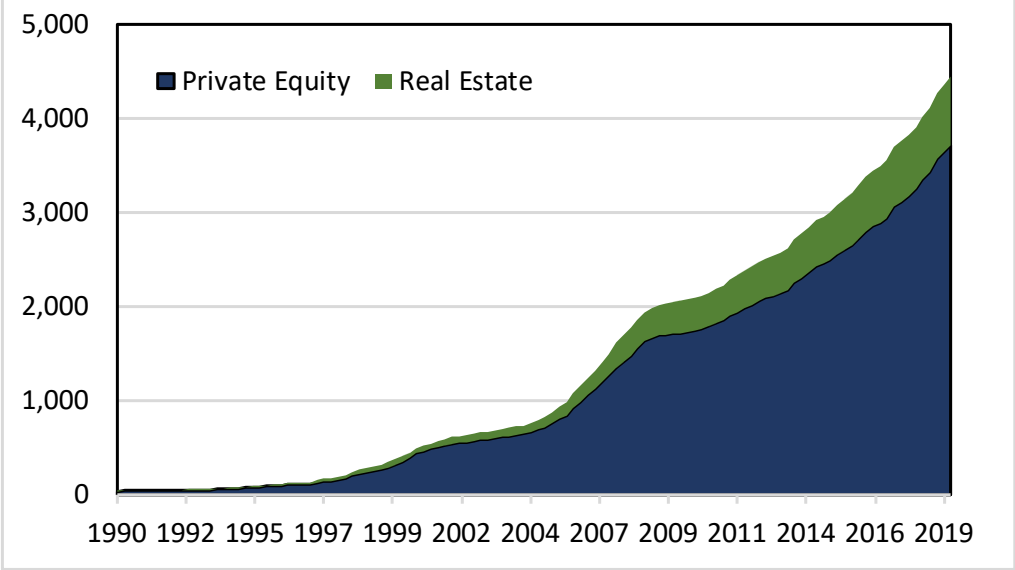
Hedge Fund AUM: 1990 – 2019



Notes: Data are from HHF

Figure 7

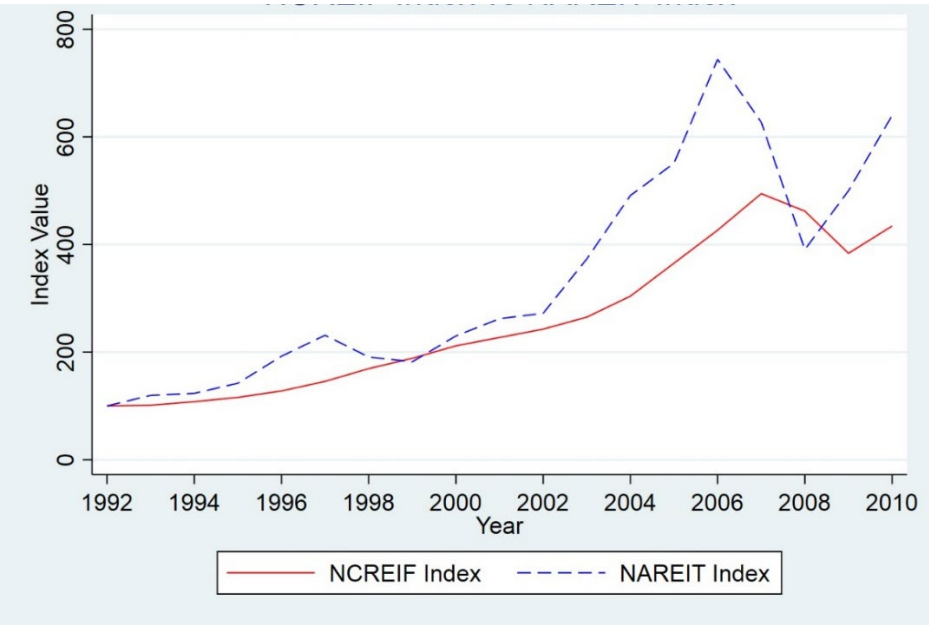
Aggregated Private Equity Fund NAV



Notes: Data are from Burgiss.

Figure 8

NCREIF v. NAREIT Index: 1993-2010



Notes: See notes to Figure 3.

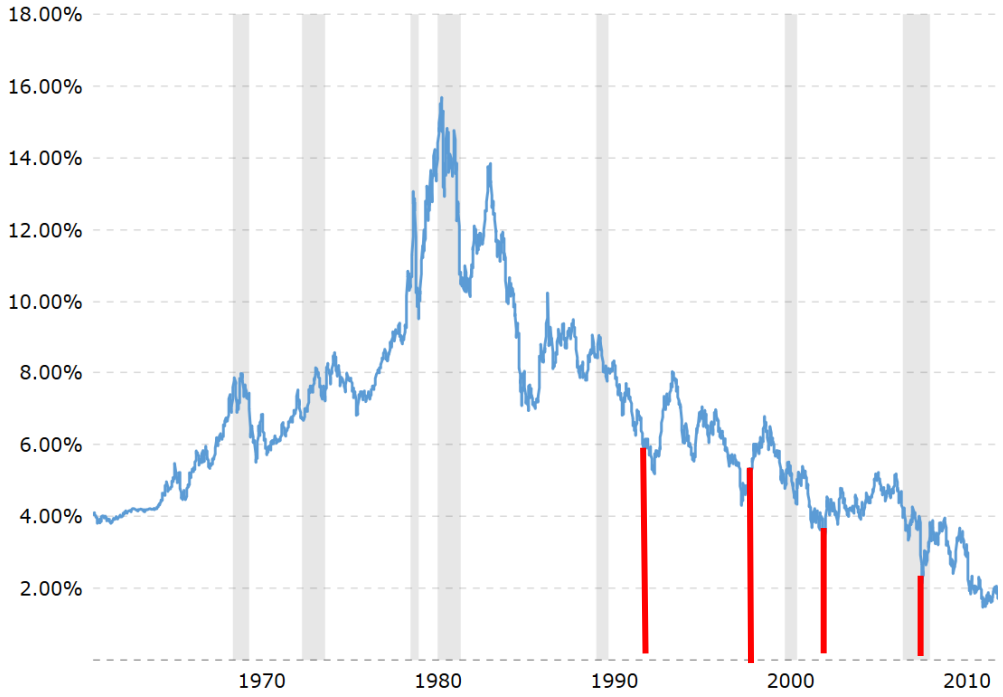
Figure 9

S&P 500 Index

Notes: Vertical red lines demarcate the sub-periods considered in section III, corresponding to year-end 1992, 1998, 2003, 2008.

Figure 10

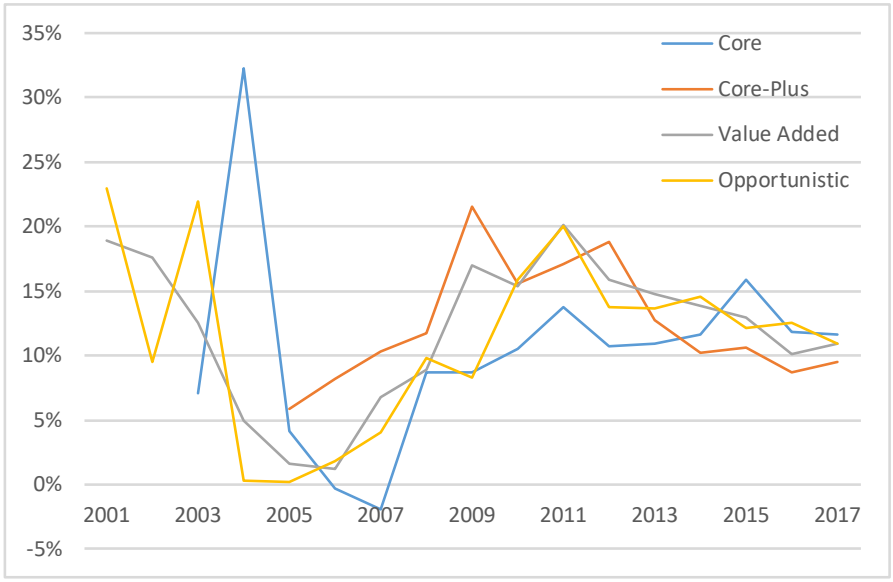
10-Year Treasury Security Yields



Notes: Vertical red lines demarcate the sub-periods considered in section III, corresponding to year-end 1992, 1998, 2003, 2008.

Figure 11

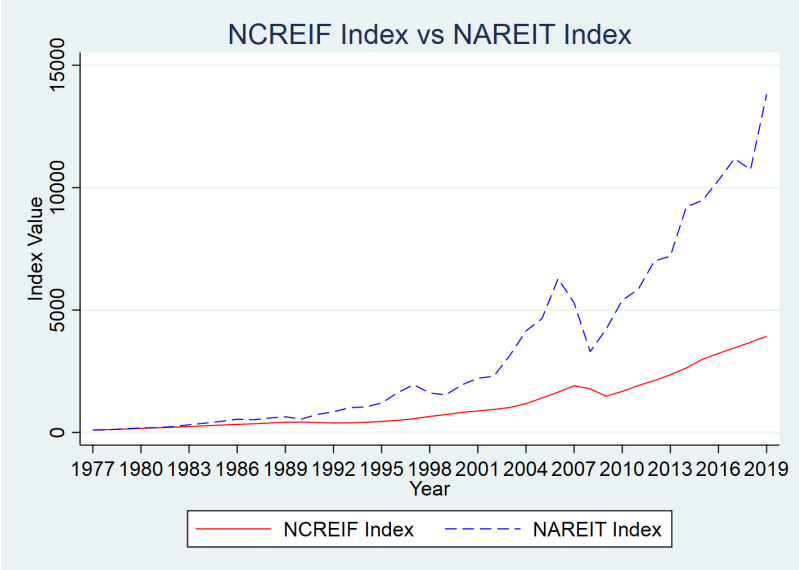
PERE Fund IRRs by Vintage Year and Category



Notes: Preqin data are used to construct non-weighted average IRRs by vintage and fund category.

Figure 12

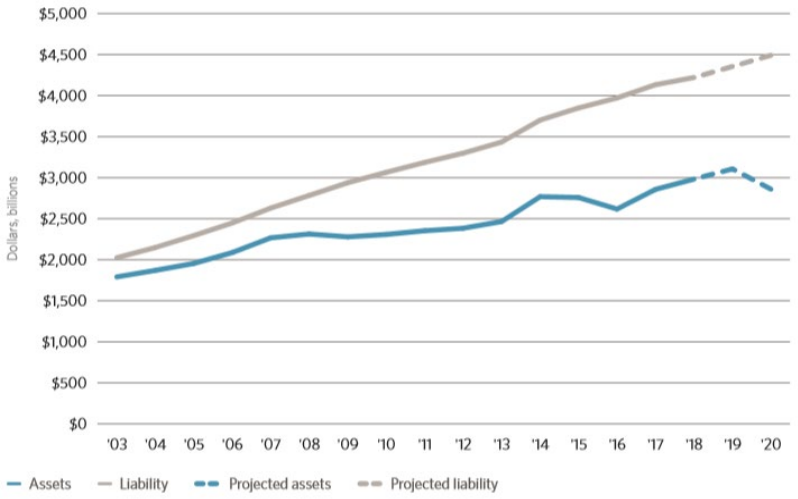
NCREIF v. NAREIT Index: 1978-2019



Notes: See notes to Figure 3.

Figure 13

Public Pension Fund Asset-Liability Funding Gap

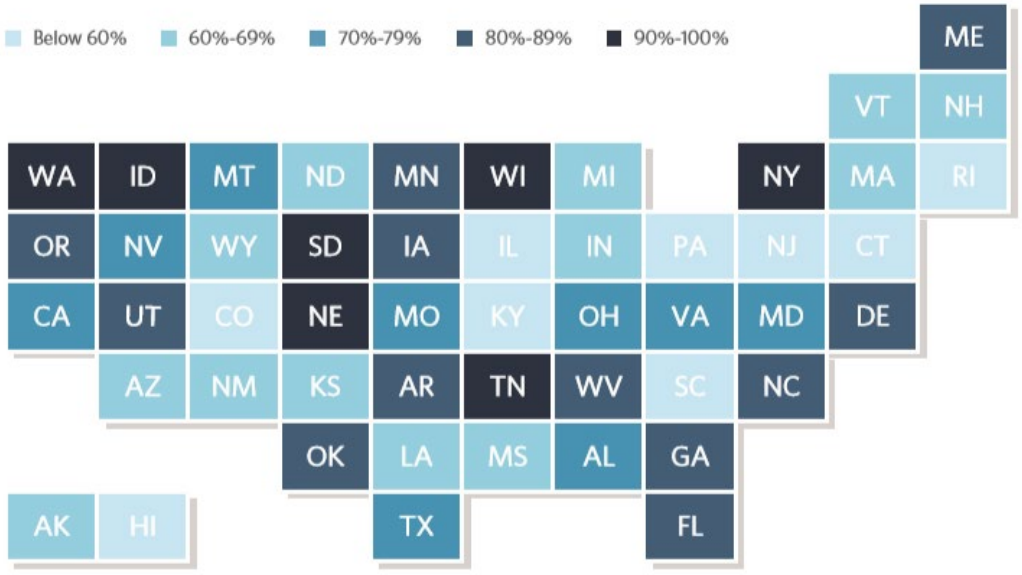


Notes: Projections for 2019 and 2020 are based on past growth of service cost, benefit payments, and contributions as well as actual returns for FY 2019 and estimated returns for FY 2020.

Sources: Comprehensive annual financial reports, actuarial reports and valuations, other public documents, or as provided by plan officials.

Figure 14

2018 State Funding Levels



Note: Numbers reflect the Governmental Accounting Standards Board reporting standards as of 2018.

Sources: Comprehensive annual financial reports, actuarial reports and valuations, other public documents, or as provided by plan officials

Table 1

Ibbotson and Siegel Study: 1947-82

Panel A: Means and Standard Deviations of Returns

Investment Category	Mean Return	S.D. Return
Stocks	11.00%	17.52%
Long-term Bonds	2.99%	9.71%
Treasury Bills	4.44%	3.29%
Real Estate	8.03%	3.78%

Panel B: Correlations of Returns

Investment Category	Stocks	Long-term Bonds	Treasury Bills	Real Estate
Stocks	1.0			
Long-term Bonds	.14	1.0		
Treasury Bills	−.25	.15	1.0	
Real Estate	−.06	−.08	.44	1.0

Notes: Taken directly from Tables 1 and 3 in Ibbotson and Siegel (1984).

Table 2

Summary Performance Measures: 1978-1992

Return Statistic	NCREIF Index	NAREIT Index
Mean	9.42%	15.28%
Standard Deviation	7.55%	13.89%
Autocorrelation	.874	−.121
Contemporaneous Cross-Correlation	.167	
Lagged Cross-Correlation	.357	

Notes: Based on annual return data used to construct Figure 3. Mean return is a geometric average. Lagged cross-correlation is calculated using the time *t* NCREIF return and the time *t-1* NAREIT return.

Table 3

Growth in NCREIF Assets

Time Interval	Change in # Assets	Total % Increase	Annual Growth Rate	Net New Investment	Total % Increase	Annual Growth Rate
1980-1992	2,000	858.4%	16.3%	$29,555	5,086.9%	30.1%
1993-1998	207	9.3%	1.5%	($2,102)	(5.3%)	(0.9%)

Notes: Net new investment is in millions of dollars. Change in total number of assets is reported assets held in the index at the end of the time interval less reported assets held in the index at the start of the time interval. Total percentage increase in the number of assets is calculated by dividing the change in number of assets by total number of assets at the start of the time interval, and multiplying by 100. Annual percentage growth rate in the number of assets is calculated by, first, dividing end of interval total assets by beginning of interval total assets. This quantity is then taken to the power of one divided by the total number of years in the time interval. Finally, one is subtracted from the latter quantity, which is then multiplied by 100. Net new investment in NCREIF assets is estimated by first taking the market value (MV) of index assets at the beginning of a given year included in the time interval and multiplying it by one plus the total return for that year. That quantity is the estimated "same-store" value of NCREIF assets at the end of the year. Then, in a second step, the year-end same-store MV is subtracted from the total MV of index assets at the end of the year. The latter quantity incorporates the net value of asset acquisitions and dispositions that occurred during the year. The difference the year-end total MV and same-store MV produces our estimate of net new investment in a given year. Net new investment in all years in a given time interval are summed up to produce net new investment. Total percentage increase in new investment is calculated by dividing new investment by the market value (MV) of all NCREIF assets at the start of the time interval, multiplied by 100. Annual percentage growth rate in new investment is calculated by, first, dividing the sum of new investment and the MV of all NCREIF assets at the start of the time interval by the MV of all NCREIF assets at the start of the time interval. This quantity is then taken to the power of one divided by the total number of years in the time interval. Finally, one is subtracted from the latter quantity, which is then multiplied by 100.

Table 4

Annual Stock Returns and 10-year Treasury Rates: 1993 – 2008

Index/ Interes Rate	1/93	1993-1998	1/99	1999-2003	1/04	2004-2008	1/09
S&P 500		19.6%		−2.7%		−4.3%	
10-yr Treasury	6.57%		4.64%		4.04%		2.36%

Table 5

PERE Allocation and Investment Performance: 2001 – 2019

Year	Allocation Percent (%)	Sample Size (N)	Vintage IRR (%)	Vintage Δ-IRR (%)
2001	4.4	24(20)	16.6	5.7
2002	4.6	21(21)	10.1	0.9
2003	4.4	26(23)	21.3	10.7
2004	4.2	44(40)	5.6	(4.4)
2005	4.4	55(49)	0.5	(7.2)
2006	5.0	68(60)	(0.7)	(7.9)
2007	5.5	65(57)	4.9	(1.7)
2008	6.9	46(38)	3.9	(5.1)
Total		349(308)	4.3	(3.7)
2009	6.3	18(14)	15.2	(1.7)
2010	6.0	38(31)	14.2	1.0
2011	6.7	65(55)	18.7	8.1
2012	7.9	59(50)	14.9	4.5
2013	7.9	75(67)	14.8	4.4
2014	7.7	62(56)	15.8	5.7
2015	8.2	82(68)	10.7	(0.3)
2016	8.8	49(39)	10.4	2.9
2017	8.4	46(40)	11.9	(3.3)
2018	8.4			
2019	9.1			
Total		494(420)	14.1	3.4

Notes: Allocation percentages are from PPD. PERE sample size and IRR data are from Preqin. Only Core, Core-plus, Value-Add and Opportunity fund categories are analyzed. Sample size covers all four categories, while sample size in parentheses is Value-Add and Opportunity funds only. Vintage year is the first year in which a fund generates a cash flow. Δ-IRR is obtained by first calculating the IRR obtained from investing in the all equity FTSE-NAREIT index over the sample period, and the subtracting this quantity from the fund IRR. IRR and Δ-IRR as reported in the table are means weighted by fund size.

Table 6

PERE Allocation and Investment Performance: 2001 – 2019

Line Item	Core	Core-plus	Value-add	Opportunistic
Working Definition	Higher quality income-producing assets without any major problems to fix	Income-producing assets with one problem to fix, such as leasing vacant space or doing minor renovations	Assets requiring increased asset management, like repositioning and refurbishing, with more vacancy risk	Assets that require taking significant risk for planning, full development and leasing; perhaps operating risk as well
Fund Target IRR (net)	8.0 – 8.5%	11.0 – 12.5%	13.5 – 16.0%	16.0 – 17.5%
Fund Target Leverage	25 – 40%	50 – 60%	50 – 65%	50 – 70%

Year	Core IRR (%)	Core Δ-IRR (%)	Core-P IRR (%)	Core-P Δ-IRR (%)	Val-Ad IRR (%)	Val-Ad Δ-IRR (%)	Opp IRR (%)	Opp Δ-IRR (%)
2001	19.0	9.1	13.8	3.0	15.4	4.4	19.9	9.1
2002	--	--	--	--	17.6	9.0	(4.4)	(14.7)
2003	6.6	(4.5)	17.5	6.6	13.7	3.5	33.0	21.9
2004	31.7	22.3	--	--	8.0	(2.1)	(0.6)	(10.4)
2005	4.5	(3.0)	3.9	(4.0)	1.8	(5.8)	(1.2)	(9.0)
2006	(10.5)	(17.3)	8.0	0.6	(5.4)	(12.4)	4.1	(3.1)
2007	(37.5)	(42.3)	9.3	2.1	2.9	(3.4)	6.7	(0.0)
2008	8.0	(1.2)	10.4	2.2	6.4	(2.5)	0.4	(8.6)
Total	0.1	(7.6)	9.0	0.8	3.8	(4.2)	4.5	(3.4)
2009	11.5	(5.0)	21.5	1.1	18.0	1.1	5.1	(11.7)
2010	12.9	0.1	12.9	(0.3)	13.7	0.1	15.5	2.5
2011	11.8	1.6	18.9	8.3	20.0	9.4	18.8	8.2
2012	12.4	2.0	18.4	8.7	16.2	5.8	13.8	3.2
2013	12.9	3.6	10.2	0.8	17.2	6.7	11.8	1.2
2014	15.9	5.4	10.5	1.0	14.9	5.0	17.1	6.8
2015	5.4	(5.4)	13.3	2.6	13.4	2.2	9.3	(1.7)
2016	11.6	4.0	10.5	3.1	8.8	1.0	12.5	5.7
2017	15.9	5.6	16.6	4.0	11.5	(0.4)	11.2	(0.6)
Total	11.5	0.8	13.2	3.1	14.7	3.9	14.0	3.3

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Notes: Performance data are broken down by fund category by vintage year and are split into pre-GFC and post-GFC sample periods. Fund Target IRR and Target Leverage are obtained from PREA survey results and my own analysis of Preqin fund data. IRR and Δ-IRR are calculated as reported in the notes to Table 5.

Table 7

Top 10 GP-Sponsors in Institutional Capital Raised 2015-19

Rank	Manager	Headquarters	Capital Raised ($BN)	% Share	Cum % Share
1	Blackstone	New York	64.93	13.1	13.1
2	Brookfield Asset Mgmt	Toronto	29.01	5.9	19.0
3	Starwood Capital Group	Miami Beach	16.86	3.4	22.4
4	GLP	Singapore	16.44	3.3	25.7
5	Lone Star Funds	Dallas	16.20	3.3	29.0
6	AEW	Boston	12.23	2.5	31.5
7	The Carlyle Group	Washington DC	10.86	2.2	33.7
8	Rockpoint Group	Boston	10.74	2.2	35.8
9	BentallGreenOak	New York	9.71	2.0	37.8
10	Angelo Gordon	New York	9.45	1.9	39.7

Notes: Data from *PERE's* listing of the top 100 PERE firm ranked by capital raised in the last five years.

Table 8

Pension Fund Investment Shares in PERE, PE and HF's

Year	PPD Assets ($tr)	PERE All (%)	PERE NAV ($b)	PERE Share (%)	PE All (%)	PE NAV ($b)	PE Share (%)	HF All (%)	HF AUM ($b)	HF Share (%)
2005	2.442	4.4	143	75.1	3.9	851	11.2	0.5	1105	1.0
2006	2.630	5.0	190	68.7	4.1	1125	9.6	0.5	1465	0.9
2007	2.997	5.5	281	59.0	4.8	1422	10.1	1.3	1868	2.1
2008	2.713	6.9	322	57.8	6.6	1665	10.8	2.0	1407	3.9
2009	2.218	6.3	342	41.0	7.4	1724	9.6	2.8	1600	3.9
2010	2.450	6.0	356	41.4	8.3	1790	11.3	3.2	1917	4.1
2011	2.784	6.7	393	47.7	8.7	1945	12.4	3.7	2008	5.2
2012	2.791	7.9	414	53.5	9.2	2104	12.2	4.4	2252	5.4
2013	3.041	7.9	464	51.8	8.8	2253	11.8	5.4	2628	6.2
2014	3.404	7.7	500	52.2	8.5	2456	11.7	6.3	2845	7.6
2015	3.405	8.2	557	49.9	8.4	2658	10.8	6.7	2897	7.9
2016	3.375	8.8	603	49.5	8.5	2898	9.9	6.9	2971	7.8
2017	3.701	8.4	650	47.7	8.4	3178	9.8	7.0	3210	8.1
2018	3.859	8.4	707	45.7	9.0	3567	9.7	7.0	3102	8.7
2019	4.002	9.1	741	48.9	9.3	3867	9.6	6.8	3291	8.2

Notes: PPD assets are in trillions of dollars, while NAV and AUM are in billions of dollars. Public pension asset and allocation data are from PPD. PERE and PE NAV data are from Burgiss. HF data are from HHF. Share percentages are calculated by first multiplying PPD assets by the allocation percentage, which is then divided by the NAV or AUM, whichever is applicable.

Table 9

Institutional Ownership of CRE in 10 Largest Markets – 2017

Panel A: Global

City	Total CRE Available ($B)	II-Owned CRE ($B)	Percentage II-Owned (%)
1) Tokyo	$800	$528	66.0%
2) New York City	$631	$302	47.9%
3) Los Angeles	$457	$219	47.9%
4) Hong Kong	$443	$308	69.5%
5) Paris	$419	$281	67.1%
6) London	$410	$305	74.4%
7) Seoul	$399	$156	39.1%
8) Singapore	$263	$155	58.9%
9) San Francisco	$256	$164	64.1%
10) Shanghai	$228	$77	33.8%
Total	$4,305	$2,495	58.0%

Panel B: US Only

City	Total CRE Available ($B)	II-Owned CRE ($B)	Percentage II-Owned (%)
1) New York City	$631	$302	47.9%
2) Los Angeles	$457	$219	47.9%
3) San Francisco	$256	$164	64.1%
4) Chicago	$211	$94	44.5%
5) Washington DC	$201	$142	70.6%
6) Boston	$178	$92	51.7%
7) Houston	$146	$59	40.4%
8) Dallas	$143	$65	45.5%
9) Miami	$139	$67	48.2%
10) Atlanta	$116	$46	39.7%
Total	$2,478	$1,250	50.4%

Notes: Data are from LaSalle Investment Management, *The Real Estate Investment Universe 2018*, March 2018.