Prepared for the Government Pension Investment Fund (GPIF)

Alternative Asset Replication Using Exchange-Traded Assets

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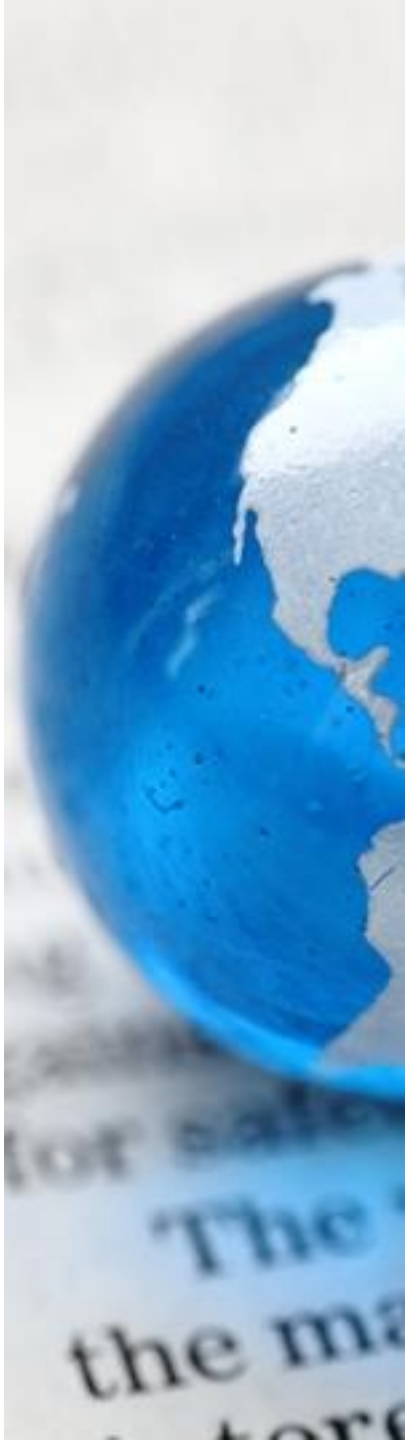

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This is the "Research and Study on Replication of Alternative Assets Using Listed Assets" project report commissioned by GPIF on 19th Mar 2020.

Introduction

- Alternative assets (hereinafter called alts) holdings have been growing in recent years. Many major Western pension funds allocate to alts to upgrade and/or diversify their portfolios. Alts offer different risk/return profiles than traditional asset classes like public equity and fixed income. They also tend to be insensitive to short-term market volatility.
- Meanwhile, alts have several drawbacks. First, they are highly idiosyncratic as a function of investment strategy and the specifics of the assets involved. Second, capital allocated to alts often sits idle for a long time before being invested. To successfully invest in alts, pension funds have to scale up their exposure over numerous years while managing risk, evaluating performance and refining their ability to select investment opportunities. Additionally, pension funds heavily allocated to alts, like certain European/US ones with double-digit alt allocations, have to address the issue of ensuring sufficient liquidity to fund pension benefit outflows.
- Alts have a reputation for not only high returns but also generally high fee rates. Given ongoing capital inflows to alts, investors presumably believe the management fees they pay for market-average returns are justified, but we wanted to find out if they have any issues with management fee structures.
- Methods to replicate alts' performance using traditional exchange-traded assets have recently been attracting growing interest. The first such methods developed were for hedge fund replication, some of which have been deployed in investment products. A number of papers have been published on private-equity performance replication also. If theories positing that market-average PE returns are replicable prove to be true, PE replication could help to mitigate alts' aforementioned drawbacks.

Introduction

- In light of such, we conducted research through interviews and data analyses to identify issues germane to implementation of replication techniques.
  - Our research revolved around the following hypotheses.

    【Hypothesis 1】 In the PE space, market-average performance is replicable in practice using exchange-traded assets. Replication would enable asset owners to rapidly scale up exposure to alts.

    【Hypothesis 2】 Asset owners believe management fees charged by market-average alt funds are reasonable in the context of alts' risk-adjusted returns and the reasonableness can be confirmed by data analyses. Also, current management fee structures have some issues from the standpoint of alts' idiosyncrasies.

    【Hypothesis 3】 Alts' performance can be monitored more appropriately by compiling alt performance data and improving performance evaluation methods.

  - Focusing on these hypotheses, we researched:

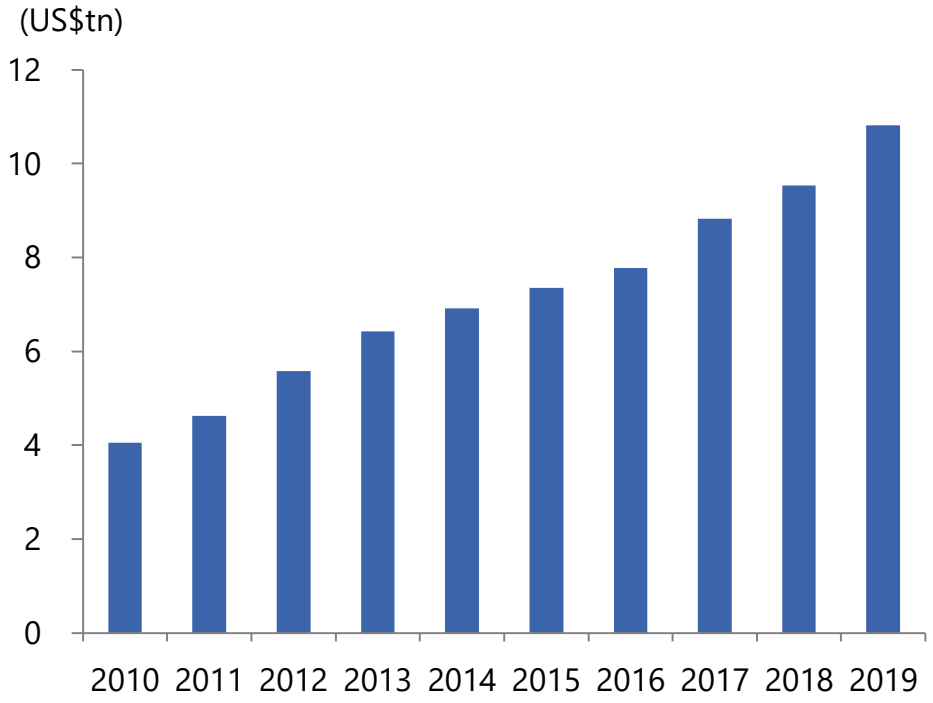
    ① Alt replication techniques that use traditional/exchange-traded assets
    ② Management fees and performance evaluation methods, and
    ③ Basics of alt performance data and indexes

- Interviews of outside experts played an important role in our research. We are grateful to the entities that cooperated with us.

Growing imperative to invest in alts in pursuit of returns and diversification

- In recent years, the pension fund industry has stepped up efforts to upgrade and diversify portfolios in response to decreased public market returns and growth in regulatory compliance costs.
- Even Japan's GPIF is allocating to alts in pursuit of better risk-adjusted returns because alts offer different risk/return profiles than public equity and traditional fixed income and tend to be uncorrelated or even anti-correlated with public markets during short-term bouts of volatility.

Alternative AUM worldwide



Source: NRI, based on Preqin Pro

GPIF initiatives to upgrade/diversify portfolio

FY13: started investing in alts

FY15: added alts to policy portfolio in 3rd Medium-Term Plan (FY15-19)

FY17: started soliciting RFPs from alt managers

Upgrade initiatives (traditional assets)

- Pairing of passive management with active management in pursuit of excess returns
- Development of expertise in benchmarks and other indexes

Diversification initiatives

- Diversification of portfolio into a wider range of assets with varied risk/return profiles, including alts in addition to foreign assets

Nearly all of the biggest pension funds are allocating to alts

- Most major pension funds are already allocating to alts.
- Western pension funds are heavily invested in alts; Asian pension funds, less so.

Alternative asset allocations of top-20 pension funds by AUM

Rank	Pension fund	Domicile	As of:	AUM (US$mn)*	Alt allocation
1	GPIF	Japan	31 Dec 2019	$1,555,550	0.6%
2	Government Pension Fund	Norway	31 Dec 2019	$1,066,380	2.8%
3	National Pension Service	Korea	31 Dec 2019	$637,279	11.7%
4	Federal Retirement Thrift	US	30 Sep 2019	$601,030	0.0%
5	ABP	Netherlands	31 Dec 2019	$523,310	27.3%
6	California Public Employees	US	30 Sep 2019	$384,435	17.2%
7	National Social Security	China	31 Dec 2019	$361,087	-
8	Central Provident Fund	Singapore	31 Dec 2019	$315,857	0.1%
9	Canada Pension	Canada	31 Mar 2020	$315,344	46.1%
10	PFZW	Netherlands	31 Mar 2020	$243,839	20.8%
11	California State Teachers	US	30 Sep 2019	$243,311	23.6%
12	Employees' Provident Fund	Malaysia	31 Dec 2019	$226,101	5.4%
13	Local Government Officials	Japan	31 Dec 2019	$224,006	0.8%
14	New York State Common	US	30 Sep 2019	$215,424	23.8%
15	New York City Retirement	US	30 Sep 2019	$208,458	14.0%
16	Florida State Board	US	30 Sep 2019	$173,769	25.8%
17	Employees' Provident	India	31 Dec 2019	$168,095	-
18	Ontario Teachers	Canada	31 Dec 2019	$159,666	48.0%
19	Texas Teachers	US	30 Sep 2019	$157,632	41.8%
20	ATP	Denmark	31 Dec 2019	$144,983	35.1%

Source: NRI, based on Willis Towers Watson press release, Pensions & Investments data and pension fund disclosures

* AUM data are current as of date in middle column; alt allocations are current as of same or more recent date.

Alts are highly idiosyncratic, require expertise

- Alts tend to be un- or anti-correlated with traditional assets, giving them the potential to deliver positive returns even during bear markets in traditional assets.
- But they require expertise due to their highly idiosyncratic nature and their complex investment structures and risk/return profiles.

Popular alternative assets

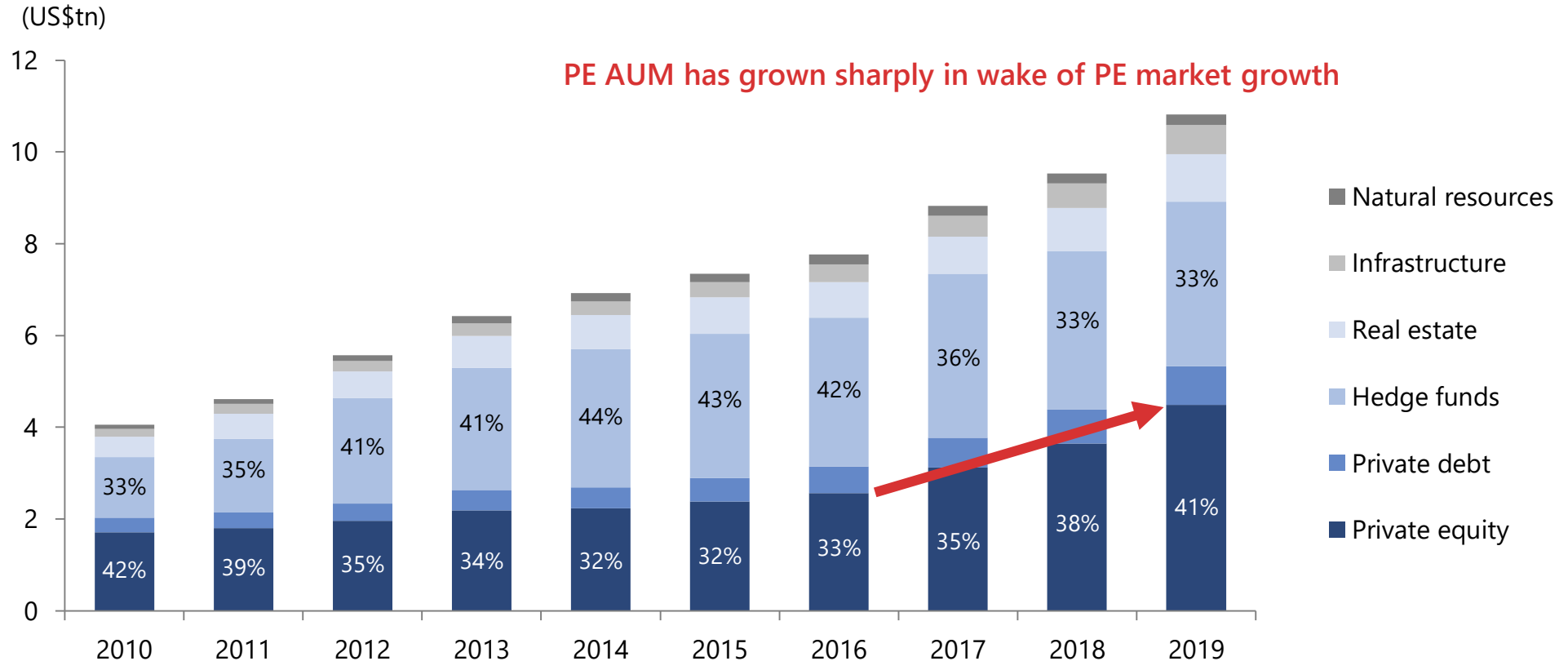
Asset	Overview
Hedge funds* (hereinafter called HF)	Investments in funds that construct portfolios from cash assets and/or derivatives in the aim of capturing absolute returns from a given strategy (e.g., arbitrage, macro, long/short).
Private equity	Investments in unlisted equities to realize gains through IPO or resale. Variants include buyout funds that wholly or partially acquire companies and resell them after adding value through management improvements; VC funds that seek capital gains by funding startups with promising technologies and selling their stakes at higher valuations; and turnaround funds that target poorly performing/distressed companies.
Private debt	Includes direct financing of unlisted companies through loans or bonds and indirect investment via credit funds. Usually higher-risk/higher-return than debt investments in public companies.
Real estate	Includes all investments aimed at earning rental income and/or capital gains from ownership of real estate, including indirect investments via funds, REITs or securitized products (e.g., MBS).
Infrastructure	Investments in, e.g., hospitals, schools, roads, tunnels, electric/gas/water infrastructure. Often financed as PPPs, many infrastructure projects are long-term investments with stable cash flows but deals vary greatly across regions/sectors. Includes both equity investments (e.g., direct investments in infrastructure operators, infrastructure fund investments) and debt investments (e.g., bonds issued by or loans to infrastructure operators).
Natural resources*	Direct or fund-mediated investments in, e.g., agriculture, energy, minerals, timber. Ex-ante returns and risk profiles differ among natural resources subsectors. Natural resource investments are popular with institutional investors for their long holding periods and diversification benefits vis-à-vis public markets.

* GPIF's definition of alternative assets currently does not include hedge funds or natural resources but they are generally considered alternative assets.

PE AUM recently growing, driven by strong investor appetite for PE

- PE and hedge funds collectively account for lion's share of alternative AUM.
- PE market has grown dramatically since 2016, reflecting PE's growing popularity.

Global alternative AUM



Source: NRI, based on Preqin Pro; percentages are PE and HFs' respective shares of total

Can replication deliver positive real returns while rectifying alts' illiquidity?

- Drawbacks of alt investing include illiquidity, not enough supply to meet demand, high fees and risk measurement challenges.
- To be practically applicable, alt replication must provide adequate returns and sufficient liquidity to meet pension benefit obligations. One potential approach is to apply HF replication techniques to other alts.

Our research process

① Identify drawbacks of alt investing

② Do research addressing them

i. Gather alt performance data and basic information on alt indexes

ii. Gather information on alt replication methods that use traditional exchange-traded assets

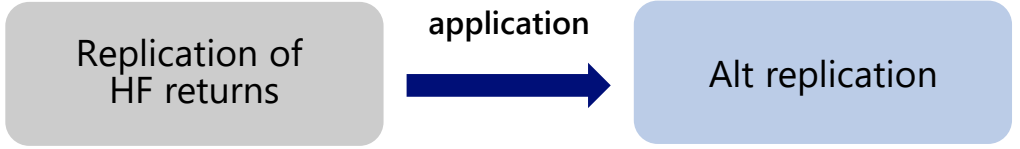
iii. Gather information on management fees and performance evaluation methods

iv. Identify challenges to implementing the replication and performance evaluation methods

③ Experiment with implementing said methods

Reference: HF replication has 10+ year track record

- Replication seeks to mimic an asset's returns by constructing a portfolio of exchange-traded assets. Technical research on (mainly HF) replication dates back to ~2007.
- There are several HF replication indexes being used as benchmarks. Replication techniques are used to also value investments and quantify risk.
- HF replication techniques may be applicable to alt replication in general. Key issues that need to be addressed include illiquidity and rate-of-return calculation.



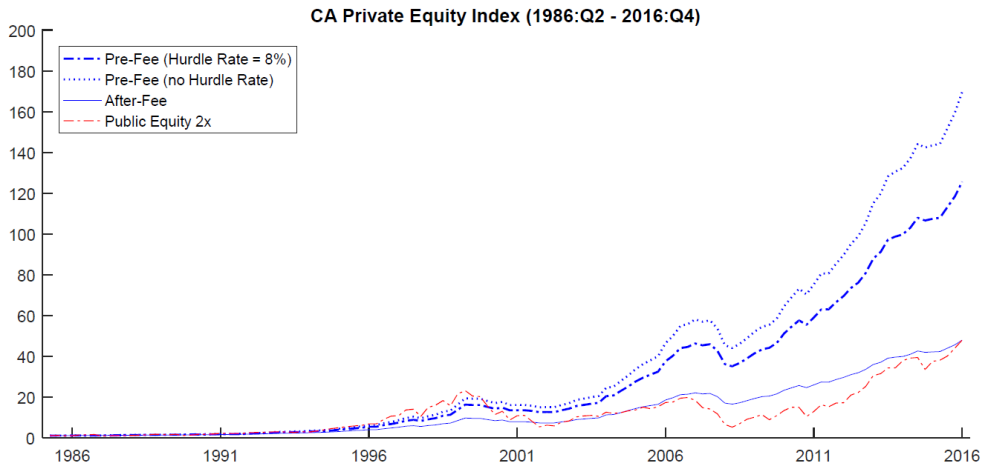
- Illiquidity
- Rate-of-return calculation
- Market impact

PE has been the focus of more replication research than any alt except HFs

- Performance replication using exchange-traded assets has been researched as one way to ameliorate drawbacks of alt investing: investment capacity constraints, illiquidity and long payback periods.
- With HF replication now common, academics and practitioners will presumably continue to work on replicating the performance of other alts, particularly PE.

Replication theory: Harvard Business School

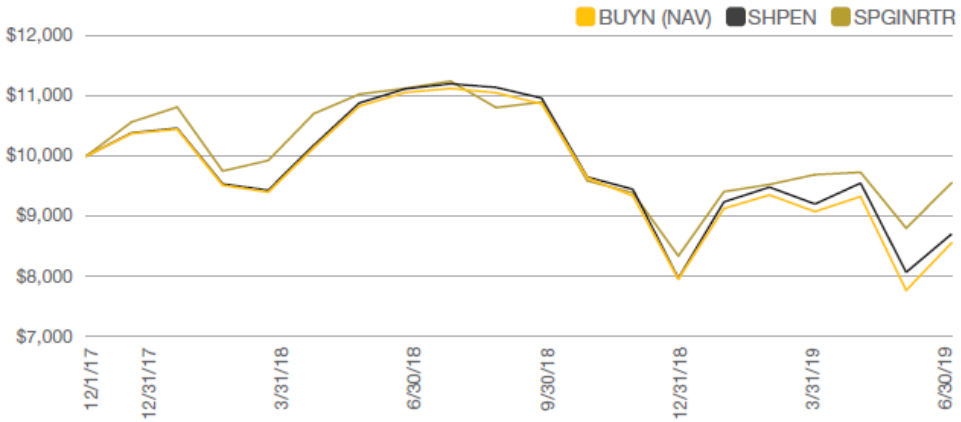
- PE funds' investment process combines value investing, leverage, long holding periods, conservative net asset valuation and active management.
- PE returns net of fees are similar to replicated returns.



Source: NRI, based on Erik Stafford, Replicating Private Equity with Value Investing, Homemade Leverage, and Hold-to-Maturity Accounting (December 2015)

USCF has applied replication theory in practice

- The US asset manager USCF has created two passive ETFs based on PE replication theory.
  - USCF SummerHaven SHPEN Index Fund (BUYN)
  - USCF SummerHaven SHPEI Index Fund (BUY)



Source: Excerpted from USCF SummerHaven SHPEN Index Fund's 2019 Q2 disclosures

01 Purpose and Background of Study

02 Interview Survey of Outside Experts

03 Data Analyses

04 Summary

※Corresponding part of this section was translated by the author and reprinted from the October 2018 issue of the Securities Analysts Journal(r) with the permission of the Securities Analysts Association of Japan (SAAJ).

Survey methodology

- We interviewed experts on performance replication about its real-world utilization and the challenges involved.
- We selected interviewees deemed to possess the targeted expertise based on a review of advanced research on and case studies of replication.
- The interviewees were split roughly 20:40:40 between asset owners, traditional asset managers and academicians et al. Geographically, they were split roughly 35:65 between Japan and overseas.

Interview survey flow

Selection of interviewees	Advance notice of questions	Interviews (in person, online)	Follow-up
• We selected interview candidates who met our eligibility criteria	• We sent interviewees a list of questions on performance analysis, management fees and alt replication	• We interviewed them in person or by video- conference • We discussed their answers and related topics	• We followed up to delve deeper into certain matters • We referred to related academic literature, etc.

Interviewee eligibility criteria

- Must be an asset owner, asset manager (of traditional assets), academician or information vendor
- Asset owners and asset managers must possess expertise in investment/performance replication techniques
- Academicians and information vendors must possess expertise in investment/performance replication techniques

Interview survey questions

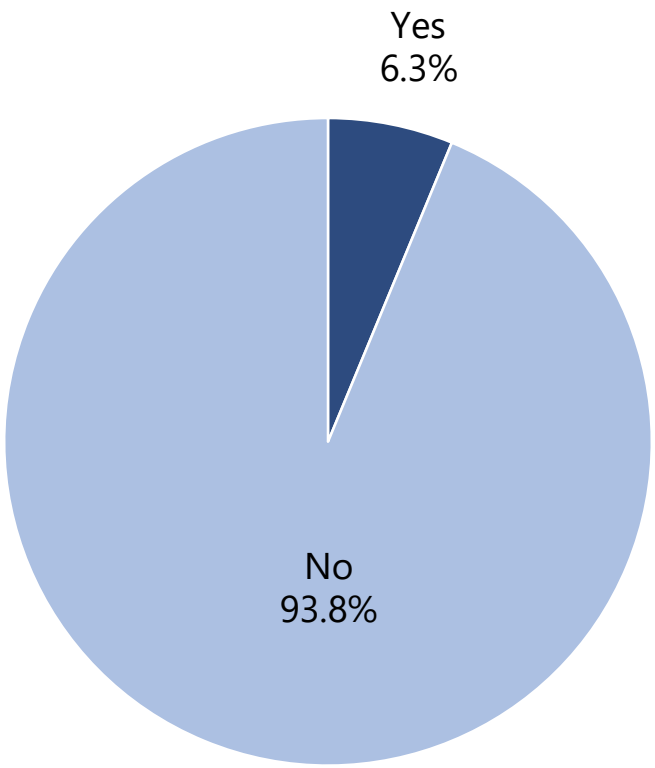
- In the interview survey, we asked the following questions about PE grouped into four categories.
- We learned from the interviewees about replication methods and their experiences using them.

Performance replication	【Q1】 Do you use performance replication methods in practice? 【Q2】 How should performance replication methods be used?
Fund management fees	【Q3】 Do you have any issues with PE fund management fees?
Performance evaluation	【Q4】 How do you measure performance? 【Q5】 What index(es) do you use?
Japanese market	【Q6】 Where does Japan's PE market fall short?

Expert Interview Findings

Q1: Do you use performance replication methods in practice?

Breakdown of responses



Summary of responses

- A vast majority do not use replication methods.

Examples of actual uses of replication methods

- To define factors common to PE-investee companies that delivered outsized returns
- To test PE-replicating portfolios composed of public equities

Examples of reasons against their use

- Replicating-portfolio's backtest results were too volatile
- With some replication methods, PE returns' replicability with exchange-traded assets is limited, making it difficult to differentiate PE replication from public equity investment

Types of and approaches to performance replication (reference)

- HF replication techniques developed the 2000s can be broadly classified as either top-down or bottom-up approaches.
- The former aims to replicate the performance of an index in aggregate; the latter, to construct a portfolio similar in composition to the index※.
- The most common replication approach in the PE space is bottom-up, also known as strategy replication. Our interviewees advocated two types of strategy replication methods: company-level replication and index-weight replication.

Index being replicated

Top-down replication strategy

■ Return replication

- Focuses on replicating the targeted returns and optimizes for, e.g., minimization of time-series tracking error
- Replication of PE market index returns is not widely practiced because available datasets are prohibitively small.

Bottom-up replication strategy

Most common PE replication approach

■ Strategy replication

- Focuses on replicating the targeted strategy in the aim of constructing a portfolio similar thereto.
- Does not directly replicate returns. Replication accuracy consequently depends largely on replicating-portfolio's similarity to targeted strategy.
- PE market index replication methods shared by our interviewees fell into two categories: company-level replication and index-weight replication.

Company-level replication
Replicates PE-investee companies' respective fundamentals

Index-weight replication
Replicates PE index weights

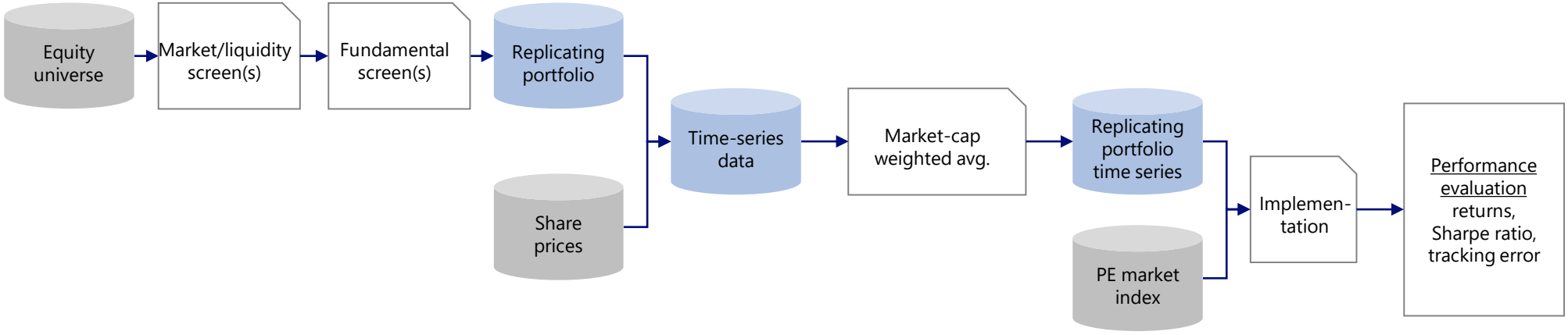
* Peter Hecht, Hedge Fund Replication: Is It Appropriate for You?, Evanston White Paper, (2014) https://www.evanstoncap.com/docs/news-and-research/evanston-capital-research---hedge-fund-replication.pdf

Strategy replication: company-level replication (reference)

- Method: construct a portfolio by selecting single-name stocks with attributes (e.g., region, size, liquidity, fundamentals) similar to those of PE-investee companies in the index being replicated
  - Replicating-portfolio construction method
    - Screen stocks based on the replication target's attributes (e.g., region, size, liquidity, fundamentals)
    - Screen stocks based on fundamental factors (e.g., EBITDA multiple)
  - Implementation method
    - Invest in periodic installments à la dollar cost averaging
    - Evaluate performance based on, e.g., returns, Sharpe ratio, tracking error between replicating portfolio and PE market index
- We used the paper below as a reference on how to construct company-level replicating portfolios:

  Erik Stafford, Replicating Private Equity with Value Investing, Homemade Leverage, and Hold-to-Maturity Accounting, Harvard Business School Working Paper May 2017.

Replicating-portfolio construction and implementation

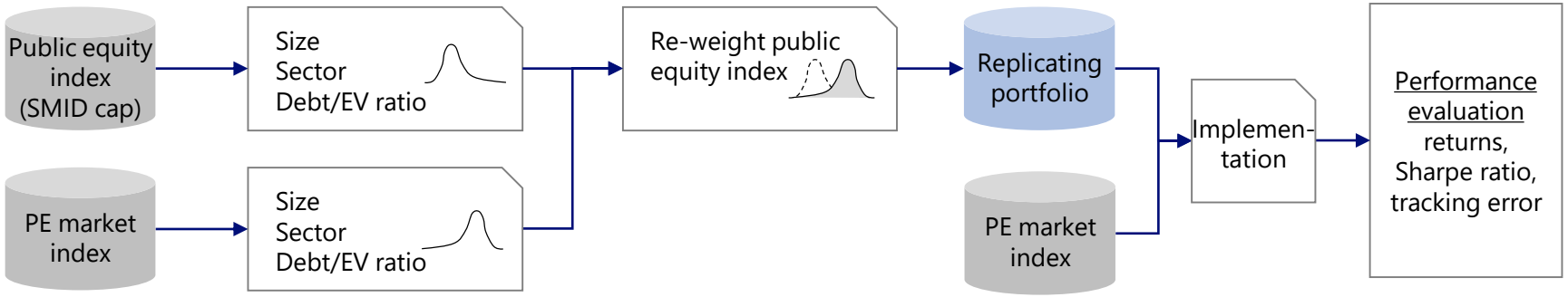


Strategy replication: index-weight replication (reference)

- Method: construct a replicating portfolio by re-weighting a public equity index to mimic a PE market index's attributes
  - Replicating-portfolio construction method
    - Select small and mid cap public equity index
    - Select PE market index to be replicated
    - Re-weight public equity index to mimic PE market index's attributes (e.g., size weights, sector weights, fundamental tilts)
  - Implementation method
    - Invest in periodic installments à la dollar cost averaging
    - Evaluate performance based on, e.g., returns, Sharpe ratio, tracking error between replicating portfolio and PE market index
- We used the paper below as a reference on how to construct index-weight replicating portfolios:

  Jean-François L'Her et al., A Bottom-Up Approach to the Risk-Adjusted Performance of the Buyout Fund Market, Finance Analysis Journal, December 2018

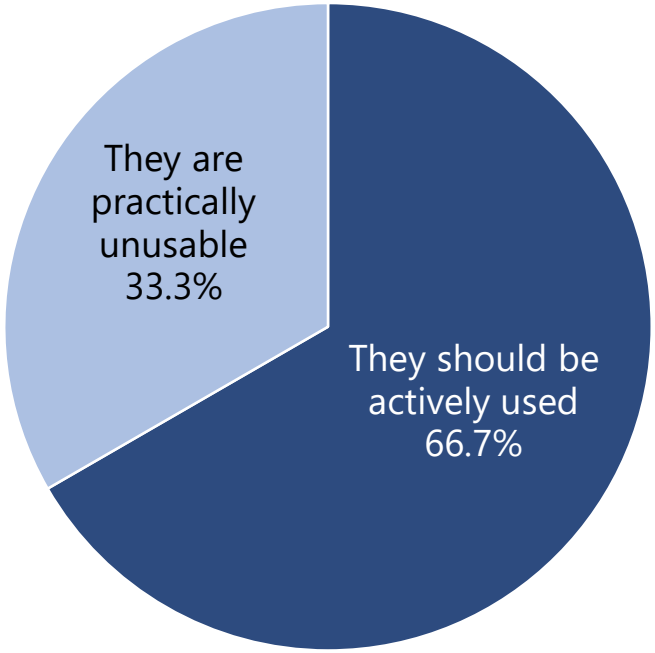
Replicating-portfolio construction and implementation



Expert Interview Findings

Q2: How should performance replication methods be used?

Breakdown of responses



Summary of responses

- Some interviewees, mostly asset managers researching replication methods, suggested a number of use cases, including ones peripheral to portfolio management.

Use case 1: to park funds awaiting capital call

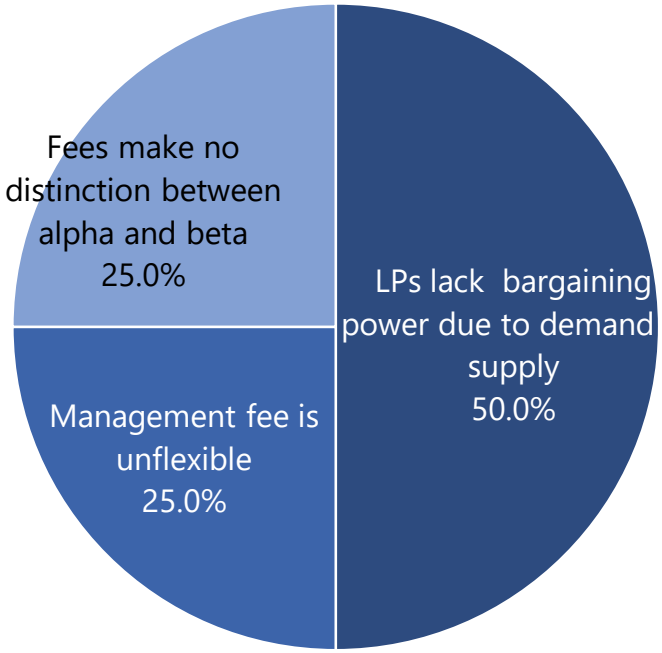
- One drawback of PE investing is that committed capital often sits idle for a long time awaiting a capital call. Replicating portfolios could be used to invest such funds kept on standby.

Use case 2: to expand investment capacity

- Replicating-portfolios composed of public equities can potentially provide enough investment capacity to fully accommodate big institutional investors

Q3: Do you have any issues with PE fund management fees?

Breakdown of responses



Summary of responses

- Interviewees raised three major issues.

With demand > supply, investors lack bargaining power

- Balance of power between GP and LPs is skewed by surfeit of demand over supply
- LPs lack skills/resources to identify and negotiate with funds capable of delivering excess returns

Management fee rates are fixed, disincentivizing LPs from upsizing investments

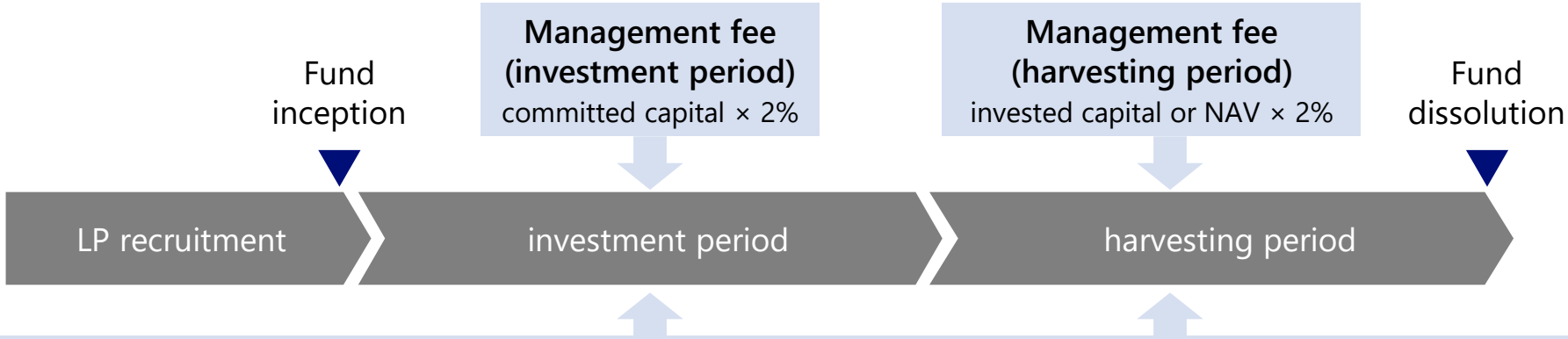
- Management fee rate is usually ~2% irrespective of fund size
- Large funds should have sliding-scale management fee rates that decrease as AUM grows

Performance fee rate is charged even on beta

- PE fee rates seem to make no distinction between alpha and market beta
- Some interviewees want to limit performance fees to alpha only, a common practice in other asset classes

Typical PE fund fee structure (reference)

- Our interviews corroborated that PE funds' typical fee structure and standard fee rates are as follows.
- Fee rates, catch-up clauses and clawback clauses differ as a function of funds' strategy, size and target investees.



Performance fee

- **20% of gross returns** (returns are split 80:20 between LPs and GP, subject to a hurdle rate and catch-up clause)
- **8% hurdle rate**
  Performance fee is charged on gross returns in excess of hurdle rate, which may apply on deal-by-deal basis (American waterfall) or overall-return basis (European waterfall)
- **Catch-up clause**
  Provides for preferential distribution of gross returns to GP once hurdle rate has been reached (see next slide for more details)
- **Clawback clause**
  Requires GP to refund to LPs performance fees previously charged on deal-by-deal basis, to the extent GP ends up being overpaid on overall-return basis.

Typical PE fund fee rates (reference)

■ Performance fees are based on idea of GP and LPs splitting total returns in proportion to performance fee rate.

- Most PE funds are subject to a hurdle rate and catch-up clause, where returns are preferentially distributed to LPs until the hurdle rate (HR) is reached.

Management fee + **Performance fee (80:20 split between LPs/GP)**

Fund inception → Fund dissolution

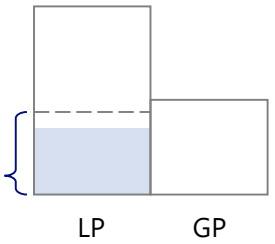
LP recruitment | Investment period | Harvesting period

Management fee (investment period)
committed capital × 2%

Management fee (harvesting period)
invested capital or NAV × 2%

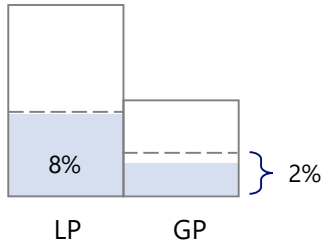
① While cumulative returns < HR:

Returns preferentially distributed to LPs



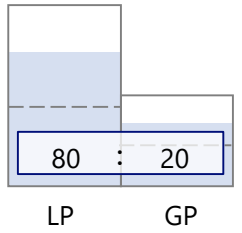
② While cumulative returns > HR but GP's share < 20%:

Returns preferentially distributed to GP until GP has received 20% share



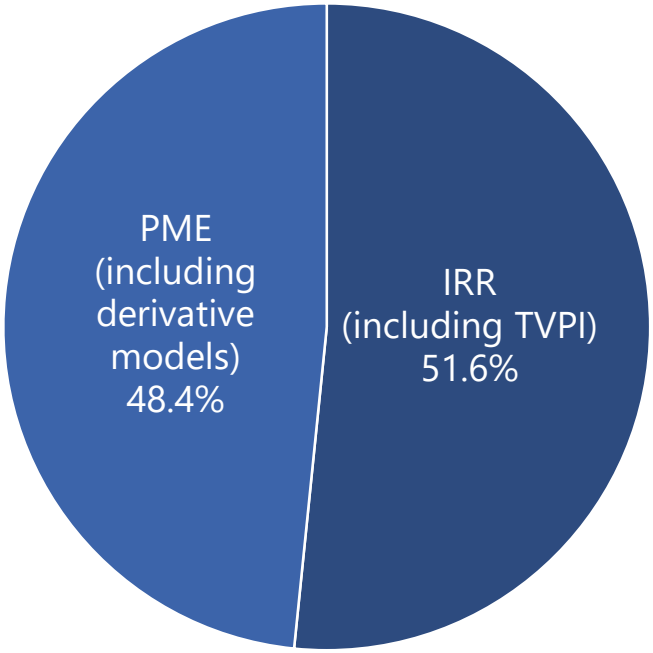
③ Once GP is fully caught up:

Returns are distributed in 80:20 ratio to LPs and GP, respectively



Q4: How do you measure performance?

Breakdown of responses



Summary of responses

- Interviewees cited two main performance metrics.

IRR (internal rate of return)

- Measures return on investment (absolute returns)
- Industry standard; GIPS-compliant returns are IRRs
- May not reflect actual returns because IRR formula implicitly assumes cash flows are reinvested at IRR

PME (public market equivalent)

- Measures outperformance/underperformance vs. public market returns (relative performance)
- Easy to use; compatible with common PE practice of targeting returns in excess of public market returns
- Some early methods do not work in cases where PE fund greatly outperforms public market benchmark

- Both have shortcomings that can be mitigated by, e.g., combining multiple techniques or using derivative models or related metrics*

* IRR: TVPI (total value to paid-in capital), PME: Kaplan-Schoar PME, modified PME, direct alpha method, etc.

PE fund performance measurement methods (reference)

- Two main approaches are to measure (1) PE funds' absolute performance based on cash flows and residual NAV or (2) relative performance against a benchmark.
- The excess value method is recently proposed* as a candidate of the other metrics.

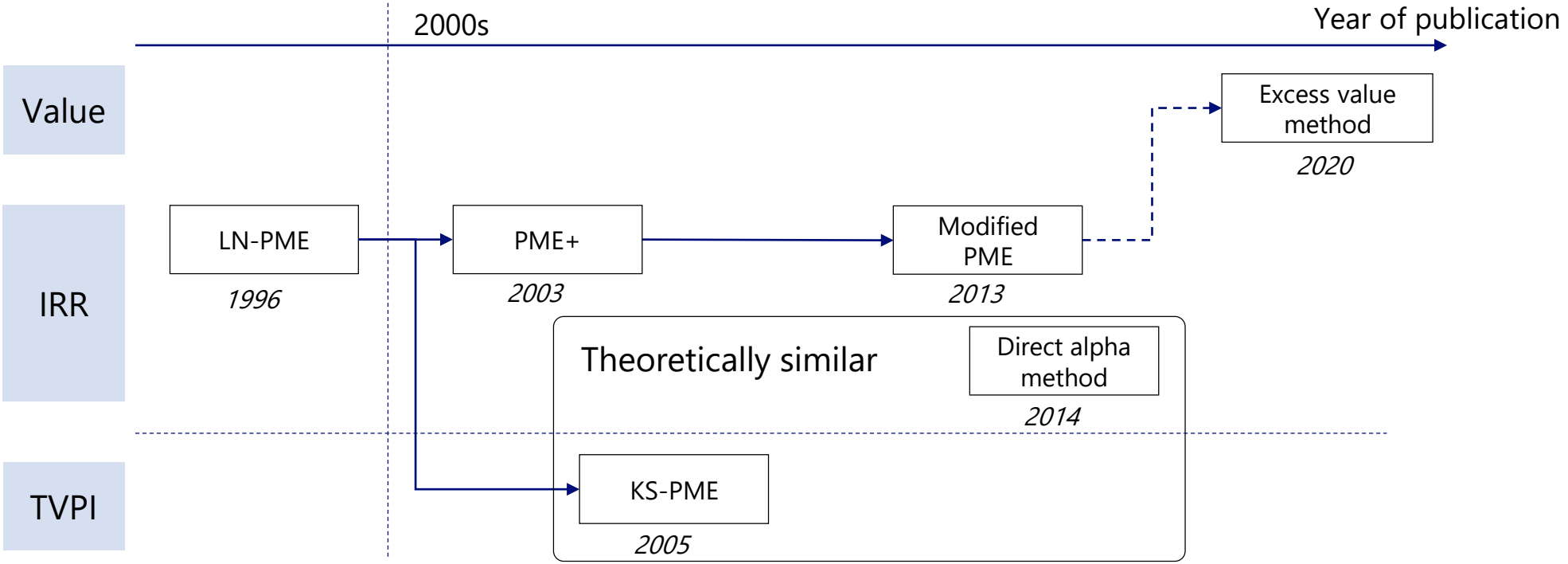
	Absolute perf.			Relative perf. (vs. public mkt)				Relative perf. (vs. PE index)	
	IRR	Modified IRR	TVPI	Long-Nickels PME	PME+	Modified PME	Direct alpha method	S&P Listed Private Equity Index	Thomson Reuter PE Buyout Index
PE cash flows	○	○	○	○	○	○	○	△	△
Timing of PE cash flows	○	○		○	○	○	○	△	△
Explicit reinvestment		○		○	○	○	○	○	
Benchmark use				○	○	○	○	○	○
Advantages	Reflects actual cash flows			Comparable to public equity indexes				Reflects NAV, is realistic	
Disadvantages	Not suitable for measuring relative performance			Is flawed in some cases	Is complex due to use of adjustment coefficients, approximations		Solves previous problems: complexity, flawed-cases	Prone to distortion by public market beta	Does not reflect CFs well, uses many estimates

* https://www.landmarkpartners.com/publications/calculating-outperformance-in-dollars-introducing-the-excess-value-method

Source: NRI, based on Japanese paper by Shinichiro Shiraki and Shinobu Miyata(Aizawa Asset Management Co.), Securities Analyst Journal, Vol 56, No.10, (2018)

Performance measurement methods' evolutionary timeline

- Performance metrics have been evolving over the past two decades, initially to rectify the Long-Nickels (LN) PME's deficiencies and more recently to increase methodological robustness.
- The Kaplan-Schoar (KS) PME and direct alpha method are highly regarded in academia. Their robustness*1 and alpha's validity as a performance measure*1,2 have been theoretically analyzed by academics.



*1. O. Gredil et al., Benchmarking Private Equity: The Direct Alpha Method, SSRN: 2403521, (2014)
*2. M. Sørensen and J. Ravi, The Public Market Equivalent and Private Equity Performance, (2014), Financial Analysts Journal, Vol. 71, No. 4, 2015, Netspar Discussion Paper No. 09/2013-039, SSRN: 2347972

Internal rate of return (reference)

- IRR is a well-known investment performance metric.
- It measures investment performance as the discount rate r that equates a PE fund's N investment cash flows $C_i (i = 0, \cdots N-1)$ with its residual NAV.

$$NAV = \sum_{i=0}^{N-1} \frac{C_i}{(1+r)^i} = C_0 + \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_{N-1}}{(1+r)^{N-1}}$$

- The 2010 Global Investment Performance Standards (GIPS) required PE funds to use IRR to measure their performance (GIPS Private Equity Requirement 7.A.3).
- Because IRR measures funds' absolute performance and embeds a "vintage effect" (broadly analogous to public market beta), it cannot measure funds' excess returns.

Long-Nickels PME (reference)

■ With the LN-PME, contributions to and distributions from a PE fund are respectively converted into purchases and sales of a benchmark index. The fund's performance is measured by comparing its residual NAV with the residual value of the hypothetical investment in the index (Long & Nickels, 1996).

Methodology

- Convert contributions to and distributions from the fund into benchmark index units by dividing the cash flow amounts by the index's contemporaneous market value.
- Calculate PME residual value by multiplying the number of hypothetical index units owned in the fund's final year by the index's then market value. Calculate IRRs for the fund and hypothetical index investment and compare the two.

Year	X	X+1	X+2	X+3	X+4	Residual NAV
①Cash flows	-1000	560	-60	280	240	300
② Benchmark	100	112	120	140	120	Residual NAV Hypoth. Inv.
Index units held (① ÷ ②)	10 (10)	5 (-5)	5.5 (0.5)	3.5 (-2)	1.5 (-2)	**180 ＝1.5×120**

Excess return: 3.84%

Vehicle/year	X	X+1	X+2	X+3	X+4	IRR
Fund	-1000	560	-60	280	240＋300	11.75%
Benchmark	-1000	560	-60	280	240＋180	7.91%

Source: NRI, based on Japanese paper by Shinichiro Shiraki and Shinobu Miyata(Aizawa Asset Management Co.), Securities Analyst Journal, Vol 56, No.10, (2018)

LN-PME does not work in certain cash-flow scenarios (reference)

- LN-PME has a known limitation (arithmetic flaw) in cases where a PE fund greatly outperforms against a benchmark.
- Alternatives such as PME+ (Rouvinez, 2003) and modified PME (Cambridge Associates, 2013) were developed to rectify this flaw.

Specific example where LN-PME does not work

- If the benchmark index declines and the PE fund outperforms the index by a large enough margin, PME residual value would be negative, rendering the hypothetical index investment's IRR incalculable.

Year	X	X+1	X+2	X+3	X+4
①Cash flows	-1000	560	-60	280	240
②Benchmark	100	70	75	70	75
Index units held (① ÷ ②)	10 (10)	2 (-8)	2.8 (0.8)	-1.2 (-4)	-4.4 (-3.2)

NAV
300

NAV Hypoth. Inv.
-330

Source: NRI, based on Japanese paper by Shinichiro Shiraki and Shinobu Miyata(Aizawa Asset Management Co.), Securities Analyst Journal, Vol 56, No.10, (2018)

* IRR cannot be calculated

- Modified methods developed to eliminate the possibility of negative residual value:
  - PME+ adjusts cash distributions so that PME residual value equals the fund's residual NAV
  - Modified PME uses a time-varying scaling factor to adjust cash distributions so that PME residual value asymptotically approaches zero instead of turning negative

Direct alpha method (reference)

- The direct alpha method (O. Gredil et al., 2014) uses changes in benchmark index as proxy for beta. This beta is used to discount the PE fund's cash flows. Alpha is then calculated directly as the fund's IRR based on its cash flows thus discounted.
  - While PME+ and modified PME rectified the LN-PME's arithmetic flaw, they did not address the problem to verify the theoretical equivalence of alpha with the difference in IRRs between the PE fund and benchmark.

Direct alpha method applied to example on preceding slide

Year	X	X+1	X+2	X+3	X+4
① Cash flows	-1000	560	-60	280	240
②Benchmark	100	112	120	140	120
③Cumulative benchmark return since $year_X$ $=(②/year_X②)-1$	–	12%	20%	40%	20%

Residual NAV
300

NAV Hypoth. Inv.
250 (=300÷1.2)

Excess return: 3.87%

Year	X	X+1	X+2	X+3	X+4
Alpha ① ÷ (1 + ③)	-1000	500	-50	200	200＋250

IRR
3.87%

Source: NRI, based on Japanese paper by Shinichiro Shiraki and Shinobu Miyata(Aizawa Asset Management Co.), Securities Analyst Journal, Vol 56, No.10, (2018)

Theoretical derivation of direct alpha method (reference)

- The return calculated by the direct alpha method is theoretically the fund's excess return over the benchmark β.
  - Reference: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2403521
- Main assumptions
  - Return r at time t is composed of a market return $\beta(t)$ and an excess return α: i.e., $r(t) = \beta(t) + \alpha$
  - Market return $\beta(t)$ is assumed as the returns of benchmark $I(t)$
- The value at time t_n of fund's cash inflow c_{t_i} that occurred at time t_i is calculated as follows :

$$v(t_i|t_n) = c_{t_i}\, exp\left\{\int_{t_i}^{t_n}[\beta(t)+\alpha]dt\right\}$$

$$= c_{t_i}\frac{I(t_n)}{I(t_i)}exp\left\{\int_{t_i}^{t_n}\alpha dt\right\} \qquad \because \frac{I(t_n)}{I(t_i)} = exp\left\{\int_{t_i}^{t_n}\beta(t)dt\right\}$$

$$= c_{t_i}\frac{I(t_n)}{I(t_i)}(1+a)^{t_n-t_i} \qquad \because exp\left\{\int_{t_i}^{t_n}\alpha dt\right\} = exp\big(\alpha(t_n-t_i)\big) = (1+a)^{t_n-t_i}$$

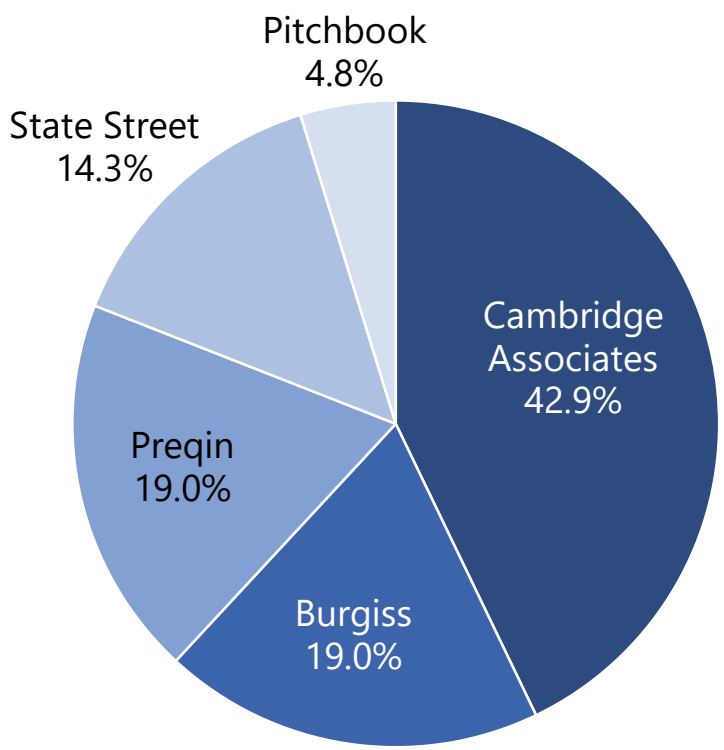
- A fund's residual NAV at time t_n is calculated as follows:

$$NAV(t_n) = \sum_{i=0}^{n} v(t_i|t_n) = \sum_{i=0}^{n} c_{t_i}\frac{I(t_n)}{I(t_i)}(1+a)^{t_n-t_i}$$

  - a is the IRR that equates the future value of cash flow c_{t_i} at time t_n to $NAV(t_n)$.
  - a is converted into excess return $\alpha = \ln(1+\mathrm{a})$.

Q5: What index(es) do you use?

Breakdown of responses



Summary of responses

- Indexes are available from the following five providers.

① Cambridge Associates

- Accurate data sourced from fund managers
- Reputation for reliability based on large LP usership

② Burgiss

- Accurate data based on cash flow info from LPs
- Suite of risk management tools; user-friendly

③ Preqin

- Popular for breadth of coverage and high-quality data validation process
- Extensive market info (e.g., dry powder, analyst info)

④ State Street

- Use of authentic data accessed in custodian role
- Accurate performance info, including cash flows

⑤ PitchBook

- Platform with highly rated U/I in addition to index

Major PE indexes (reference)

■ Major PE indexes are available from five providers.

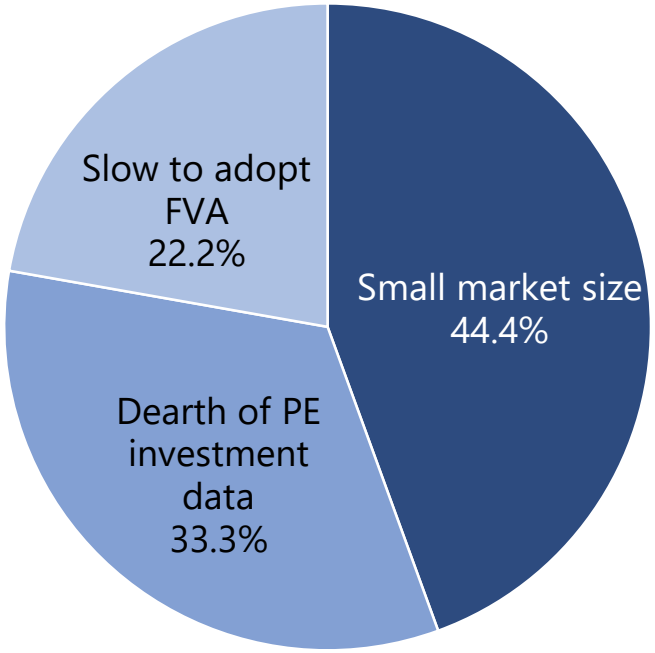
Provider	Data source(s)	Distinguishing features
Cambridge Associates	• Uses same data that fund managers (GPs) send to their investors (LPs) • Does not use FOIA requests or online web data	• Stringent quality controls that combine automated and manual data processing; updated quarterly • Builds trust through periodic communication (e.g., meetings) with fund managers (GPs) • Investor in private equity
Burgiss	• Uses data exclusively from Burgiss' clients (LPs) who use its platform • Does not use FOIA requests or data from fund managers (GPs)	• Proprietary in-house data validation process, using data that already resides within Burgiss' database • Objective benchmark as Burgiss does not provide investment advisory or consulting services
Preqin	• Uses data from fund managers (GPs) • Uses online web data (e.g., annual reports) and government/pension fund data accessed via FOIA requests	• Uses cleansed data gathered from multiple sources • Various information (on, e.g., dry powder, deal flow) available on platform
State Street	• Uses data from investors (LPs)	• Uses detailed data from PE investors (LPs) served by its custody business
PitchBook	• Uses data directly from both investors (LPs) and fund managers (GPs) • Uses online web data (e.g. annual reports) and government/pension fund data accessed via FOIA requests	• Publishes PitchBook Benchmarks report quarterly • Provides underlying deal/transaction data associated to funds • Index data available on platform and excel plugin

Source：NRI, based on information on HPs of the providers

Expert Interview Findings

Q6: Where does Japan's PE market fall short?

Breakdown of responses



Summary of responses

- Japan lags behind overseas PE markets in terms of size, data availability, benchmark availability and use of fair value accounting.

Inadequate scale

- Japanese market is smaller than overseas peers.
- Japan-domiciled PE funds* have AUM totaling ~¥3.1tn, not even 1% of global total.

Immature data environment

- Industry groups play a much smaller role in Japan than overseas in terms of data and benchmarks.
- The Japan VC Association began publishing a benchmark and performance data from June 2020.

Dearth of fair value accounting (FVA)

- J-GAAP does not mandate FVA. Many PE funds use a simplified alternative to FVA.
- If FVA becomes mandatory under J-GAAP, like under US-GAAP and IFRS, the change may unleash international capital flows into Japan's PE market.

* 2015-20 vintage funds inclusive of VC funds

Recent developments in Japanese PE market (reference)

- The Japan PE Association and Japan VC Association (respectively in collaboration with PWC and Preqin) recently began publish PE performance data and VC benchmark data, respectively.
- A BOJ report proposed promoting PE funds' involvement in restructuring of Japanese companies.

Japan PE Association survey published


JPEA プライベート・エクイティ
パフォーマンス調査
(2018年)

- 各期間の年率化内部収益率 -

2020年3月

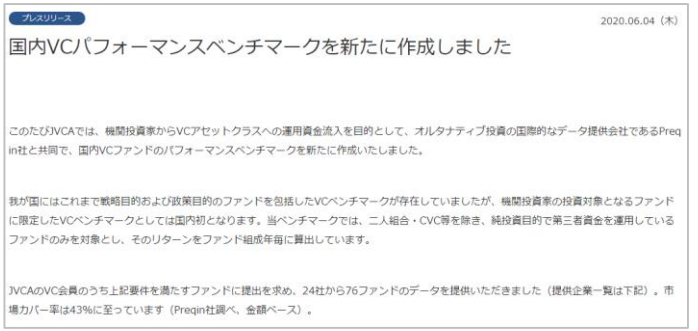
一般社団法人日本プライベート・エクイティ協会
PwCあらた有限責任監査法人

JPEA 一般社団法人 日本プライベート・エクイティ協会

pwc

Source: excerpted from Japan PE Association's PE Performance Survey (2018), released in March 2020

Benchmark launched by Japan VC Association


プレスリリース 2020.06.04（木）

国内VCパフォーマンスベンチマークを新たに作成しました

このたびJVCAでは、機関投資家からVCアセットクラスへの運用資金流入を目的として、オルタナティブ投資の国際的なデータ提供会社であるPreqin社と共同で、国内VCファンドのパフォーマンスベンチマークを新たに作成いたしました。

我が国にはこれまで戦略目的および政策目的のファンドを包括したVCベンチマークが存在していましたが、機関投資家の投資対象となるファンドに限定したVCベンチマークとしては国内初となります。当ベンチマークでは、二人組合・CVC等を除き、純投資目的で第三者資金を運用しているファンドのみを対象とし、そのリターンをファンド組成年毎に算出しています。

JVCAのVC会員のうち上記要件を満たすファンドに提出を求め、24社から76ファンドのデータを提供いただきました（提供企業一覧は下記）。市場カバー率は43%に至っています（Preqin社調べ、金額ベース）。

Source: excerpted from June 2020 JVCA press release

PE report published by BOJ


BOJ Reports & Research Papers

2020 年 12 月

わが国におけるプライベート・エクイティ・ファンドの可能性
―アイデアとコミットメントのあるファイナンスへの期待―

Source: BOJ, Prospects of Private Equity Funds in Japan, Dec 2020

01 Purpose and Background of Study

02 Interview Survey of Outside Experts

03 Data Analyses

04 Summary

Overview of data analysis themes

■ We identified three major analytic themes pertaining to issues raised in our interviews and survey of academic literature in the context of PE investing.

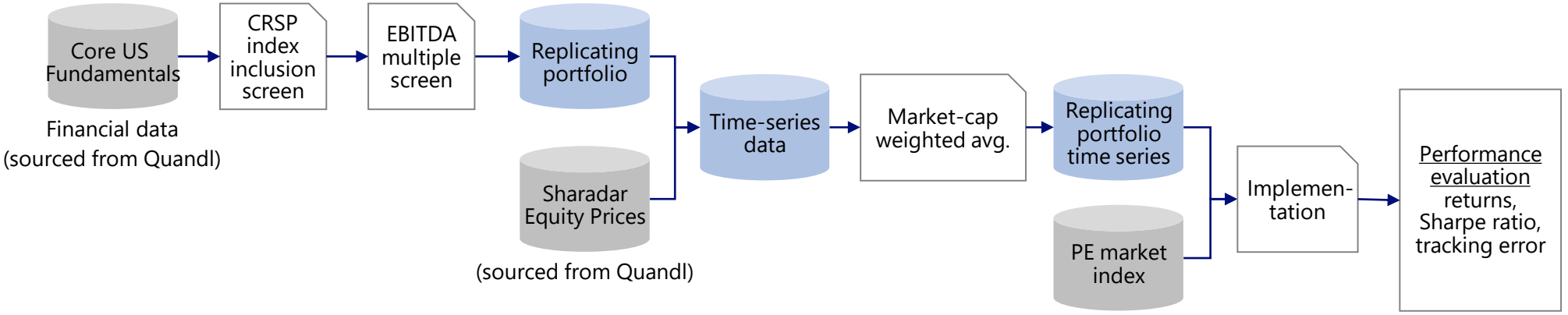
Performance replication	【Analysis 1】Company-level replicating portfolio simulation → Implement replication techniques developed by researchers, review replication results
Fund management fees	【Analysis 2】Analysis of fund management fees' reasonableness → Compare fee levels between PE and traditional asset classes
Performance evaluation	【Analysis 3】Unsmoothed performance analysis → Refine performance measurement by correcting for underestimation of volatility 【Analysis 4】Quantification of PE investment risk → Measure fund-selection risk using cross-sectional volatility

Replicating-portfolio construction and implementation method

■ We ran a replicating-portfolio simulation as a concrete example of company-level replication.

- We first applied the three criteria below referred to the CRSP methodology*1 used in prior replication research*2.
  - Companies headquartered in US and listed on NYSE, NASDAQ, NYSEMKT or NYSEARCA
  - Market cap ≥ $15mn
  - No instances of 10 or more consecutive tradeless days in previous quarter
  - 125-day trailing-average trading volume (in value terms) > 0.008% of float
- Fundamental screen
  - Low EBITDA multiple (EV/EBITDA in bottom quintile)
- Implementation method
  - We invested in 200bps monthly increments

Replicating-portfolio construction and implementation

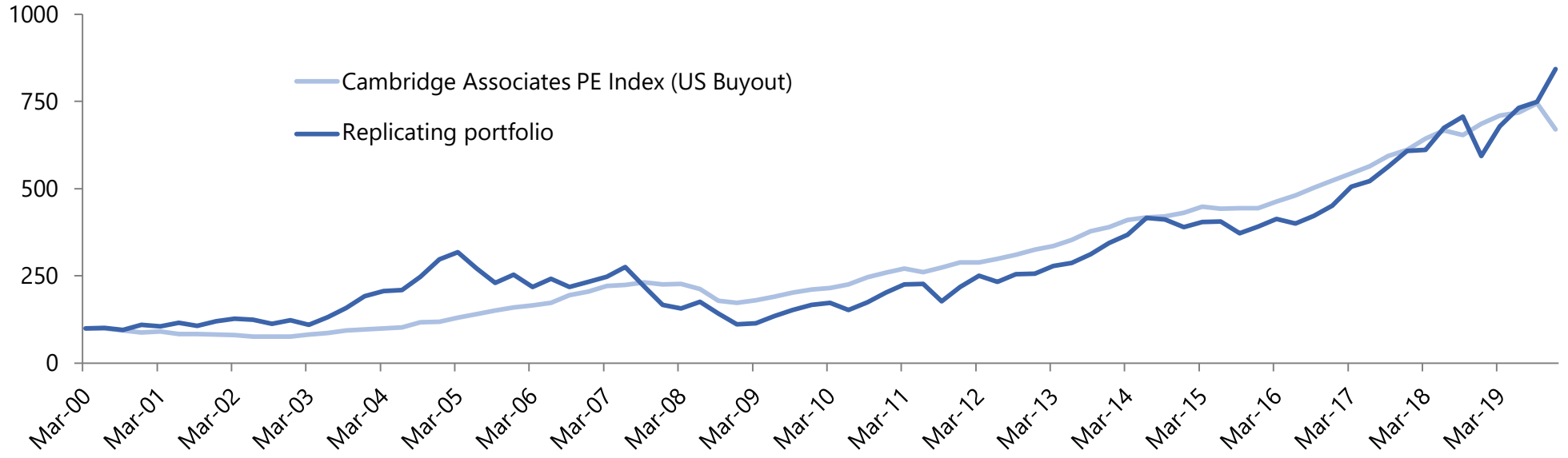


*1. http://www.crsp.org/files/Equity-Indexes-Methodology-Guide_0.pdf
*2. Erik Stafford, Replicating Private Equity with Value Investing, Homemade Leverage, and Hold-to-Maturity Accounting, Harvard Business School Working Paper May 2017

Returns comparison: replicating portfolio vs. PE market index

- The long-term performance of a replicating portfolio constructed as described on the preceding slide tracks closely with the Cambridge Associates Global PE Index (US Buyout).
- But the replicating portfolio's returns were not as stable as the index's. They had a higher standard deviation and diverged sharply from the index in 2003-06 in particular.

Returns comparison between replicating portfolio and Cambridge Associates Global PE Index (US Buyout)



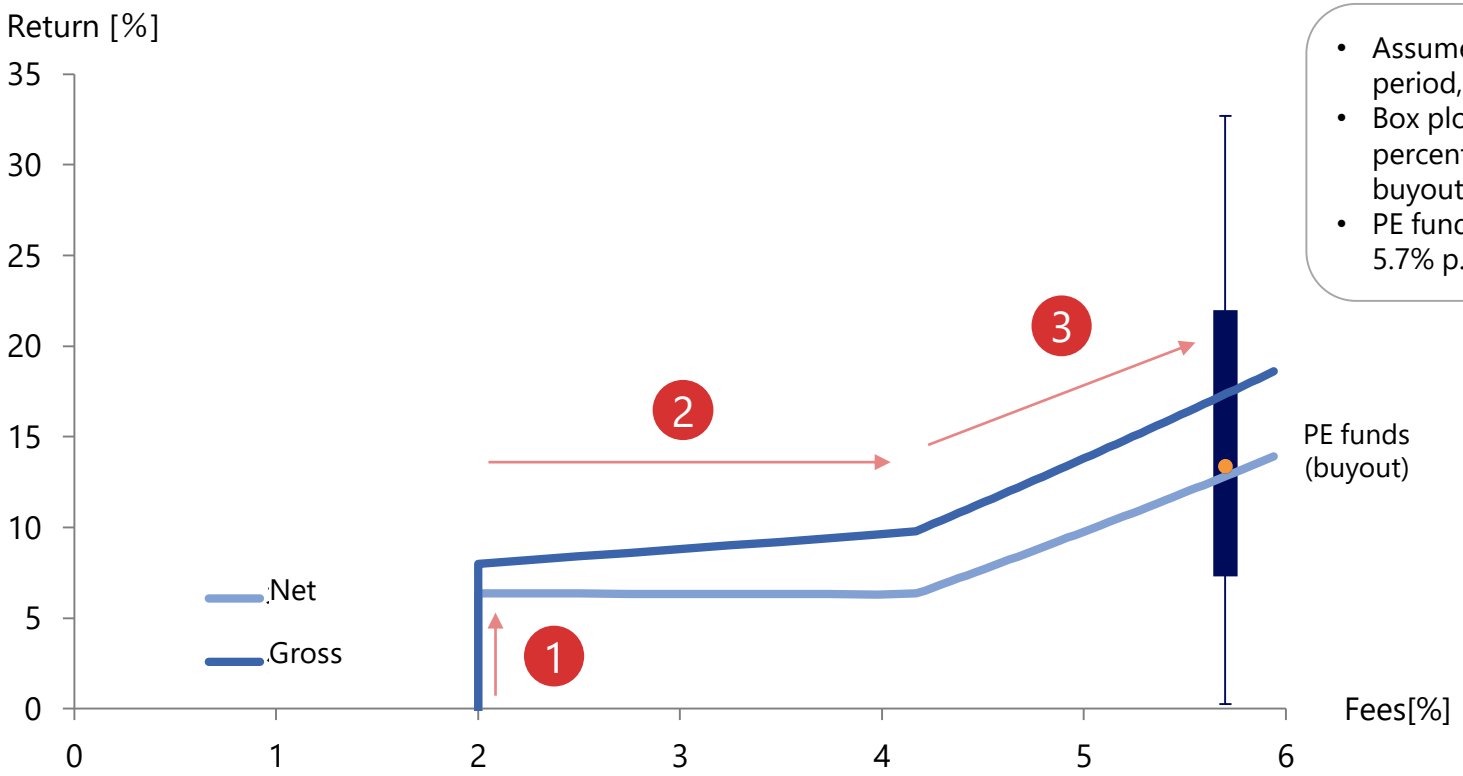
	Average return	Standard deviation	Risk-free rate (10yr UST yield)	Sharpe ratio
Replicating portfolio	13.06%	21.30%	3.39%	0.45
Cambridge Associates PE Index (unsmoothed)	13.21%	17.60%	3.39%	0.56

Source of the replicating portfolio: NRI, based on Quandl data

Relationship between returns and fees under standard fee structure

- As gross return increases, LPs' net return plotted against fees ① rises vertically until hurdle rate is reached, ② is then flat until GP is fully caught up and ③ then rise according to performance fee rate.
- PE funds have historically earned average fees of 5.7% p.a., a level commensurate with their average return of ~13% p.a. according to our simulation.

Relationship between realized returns and fees under standard fee structure



- Assumes 4yr fund life (2yr investment period, 2yr harvesting period)
- Box plot shows 90th, 75th, 50th, 25th and 10th percentile breakpoints of 1993-2017 buyout fund returns per Preqin Pro data
- PE fund fees have historically averaged 5.7% p.a.*

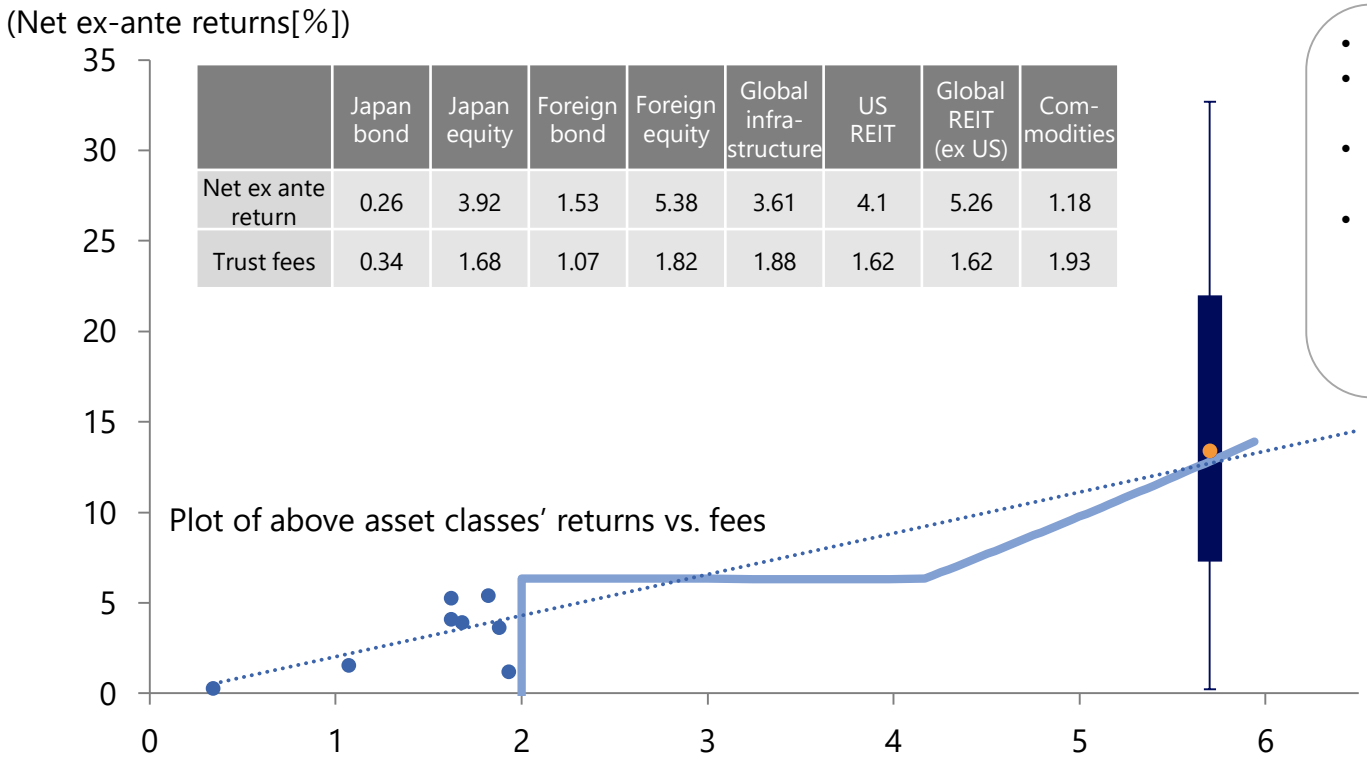
* per a 2017 McKinsey study cited in Døskeland, T. M., and P. Strömberg. (2018), as cited in Ilmanen et al., Demystifying Illiquid Assets Expected Returns for Private Equity, Journal of Alternative Investments, Vol. 22, Issue 3

PE fees largely in line with fee levels in other asset classes

- When net ex-ante returns are plotted against fees, PE funds' fee level corresponding with historical average returns is in line with other asset classes' fee levels.
- PE returns vary widely among individual funds. To earn stable returns, LPs need to be adept at manager selection.

Fee comparison between PE and other asset classes

	Japan bond	Japan equity	Foreign bond	Foreign equity	Global infra-structure	US REIT	Global REIT (ex US)	Com-modities
Net ex ante return	0.26	3.92	1.53	5.38	3.61	4.1	5.26	1.18
Trust fees	0.34	1.68	1.07	1.82	1.88	1.62	1.62	1.93



- Box plot source is from Preqin Pro
- Net ex-ante returns are gross ex-ante returns net of trust fees.
- Trust fees are the asset classes' respective public-fund averages.
- We used public fund data for this analysis because private funds generally do not disclose their trust fees. Access to private fund data would enable a more detailed analysis.

- Returns for Japanese and foreign bonds/equities are values published by GPIF for its latest policy portfolio: https://www.gpif.go.jp/en/topics/Adoption_of_New_Policy_Portfolio_details_en.pdf
- Fee rates are sample averages for actively managed public funds in each asset class, sourced from NRI FundMark/DL database.
- Alternative assets' ex ante returns were sourced from a JPMorgan report:: https://am.jpmorgan.com/content/dam/jpm-am-aem/asiapacific/jp/ja/literature/press-release/pressrelease-20191216.pdf

PE indexes putatively understate volatility

- PE funds' reported returns are said to be artificially smoothed over time by the way in which assets are appraised (i.e., their latest appraised value factors in prior appraised values) and/or statistical methods such as moving averages.
  - Similar claims have been made about appraisal-based indexes for illiquid assets like real estate.
- The most common method of unsmoothing returns is by adjusting for autocorrelation of PE index time series.
  - The usual approach is to adjust the data to eliminate the autocorrelation's effect with only one-quarter time lag. (reference: Geltner-Ross-Zisler unsmoothing process*[1,2])
    *1. D. Geltner, Bias in Appraisal-based Returns, Journal of the American Real Estate and Urban Economics Association 17: 338-352, (1989)
    *2. S. Ross and R. Zisler, Risk and Return in Real Estate, Journal of Real Estate, Finance and Economics 4: 175-190, (1991)
  - However, since the autocorrelation in PE index persists for several quarters, the approach using a method that removes autocorrelation with τ quarters (hereinafter called lag τ) is considered more sufficient.
    (reference: Okunev-White unsmoothing process*[3])
    *3. J. Okunev and White, Derek, Hedge Fund Risk Factors and Value at Risk of Credit Trading Strategies, SSRN:460641,(2003)
- Autocorrelation coefficients for Cambridge Associates and Preqin indexes' time series are tabulated below.

PE indexes' autocorrelation coefficients (ϕ_τ) by lag (* = significant at 5% level; 1 lag = 1qtr)

Lag τ		0	1	2	3	4	5	6
Autocorrelation coefficient	Cambridge Associates*4	1.000	0.342*	0.287*	0.124*	0.063	0.002	0.024
	Preqin*5	1.000	0.490*	0.387*	0.091*	0.129*	-0.045	-0.004

Coefficients calculated by NRI. *4. Cambridge Associates PE Index (US Buyout). *5. Preqin Private Capital Quarterly Index (Buyout) from Preqin Pro.

Analysis 3 Results: Unsmoothed Performance

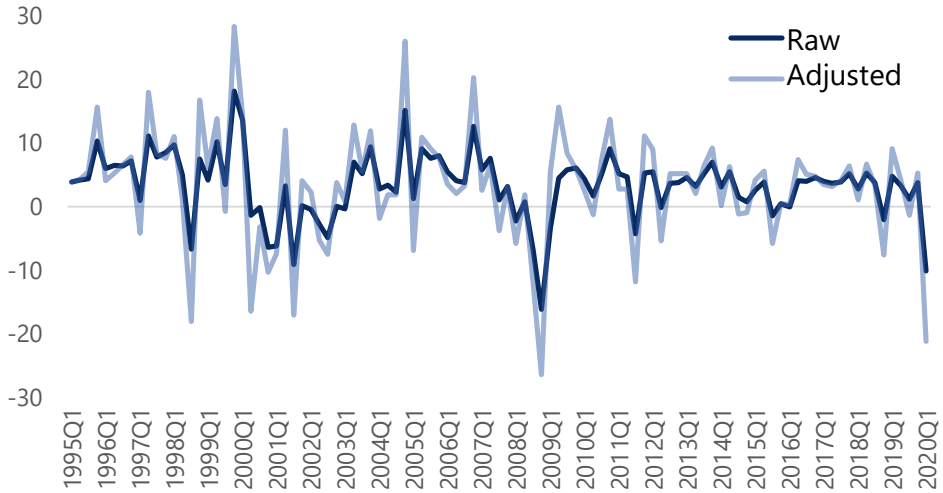
PE risk can be compared on apples-to-apples basis with other assets'

■ Removal of observed significant autocorrelation resulted in upwardly revised volatility.

- In theory, removal of autocorrelation should not alter returns but it did here because of finite datasets.

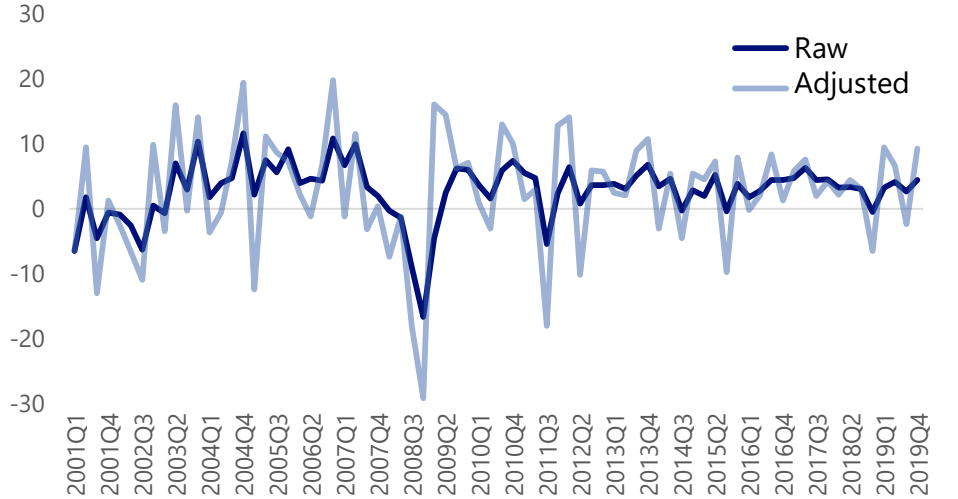
Volatility adjusted by removing time series' statistically significant autocorrelation

	Cambridge Associates PE Index (US Buyout)	Adjusted
Volatility	10.3%	17.6%
Return (geometric)	13.6%	(13.2%)



Note: Adjusted to strip out lag-3 autocorrelation. Return and volatility since 2001Q1 were respectively revised from 10.8% and 9.6% to 10.7% and 16.2%.

	Preqin Private Capital Quarterly Index (Buyout)*	Adjusted
Volatility	8.97%	15.7%
Return (geometric)	11.2%	(10.7%)



Note: Adjusted to strip out lag-4 autocorrelation

* Source: NRI, based on Preqin Pro data

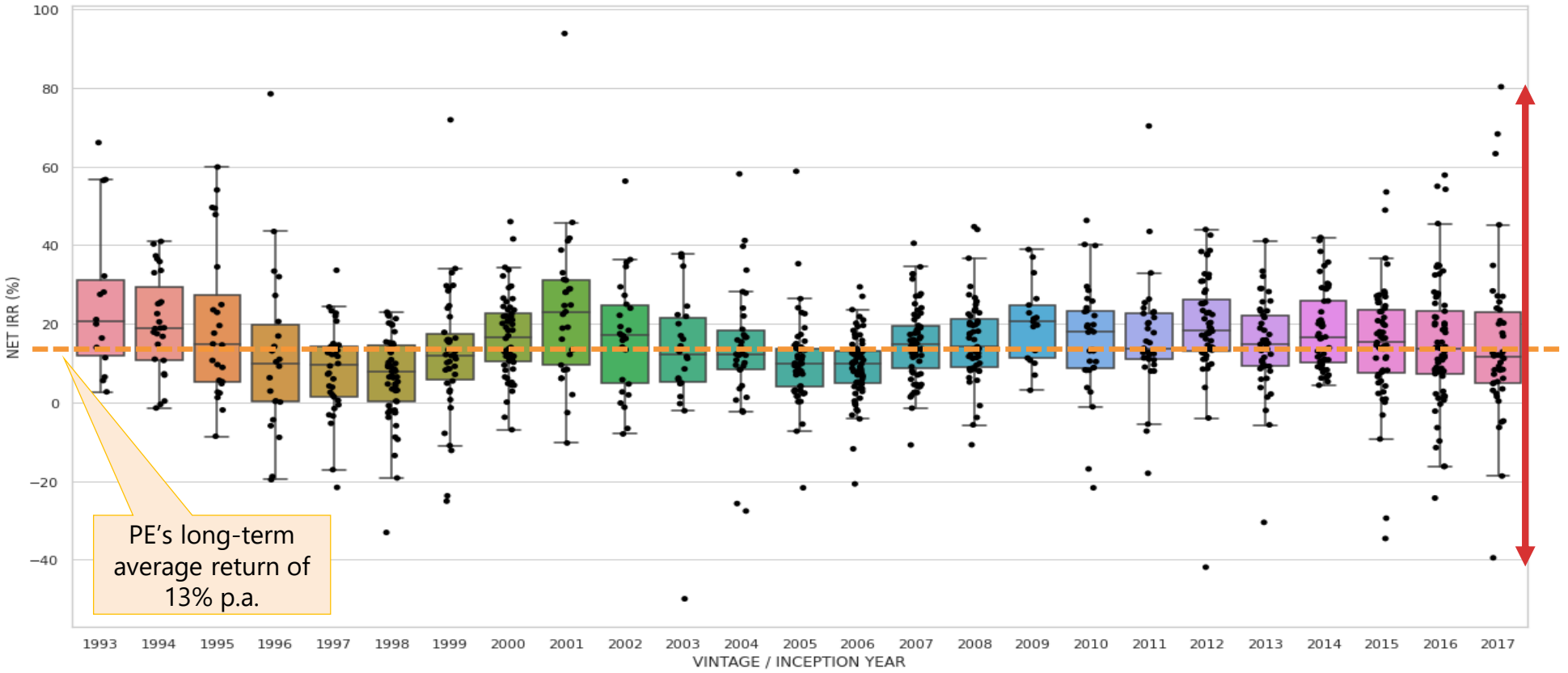
GPIF	Japan bond	Foreign bond	Japan equity	Foreign equity
Realized volatility	2.56%	11.87%	23.14%	24.85%

Source: GPIF (https://www.gpif.go.jp/en/topics/Adoption_of_New_Policy_Portfolio_details_en.pdf)

Distribution of PE funds' returns by vintage year

- While returns vary widely among individual PE funds (red line is long), they vary by vintage year also.
- The ex-ante return of 13% was achieved by ~75% of 2011- and 2012-vintage funds but only ~25% of 1997-, 1998-, 2005- and 2006-vintage funds.

PE return distribution by fund vintage year

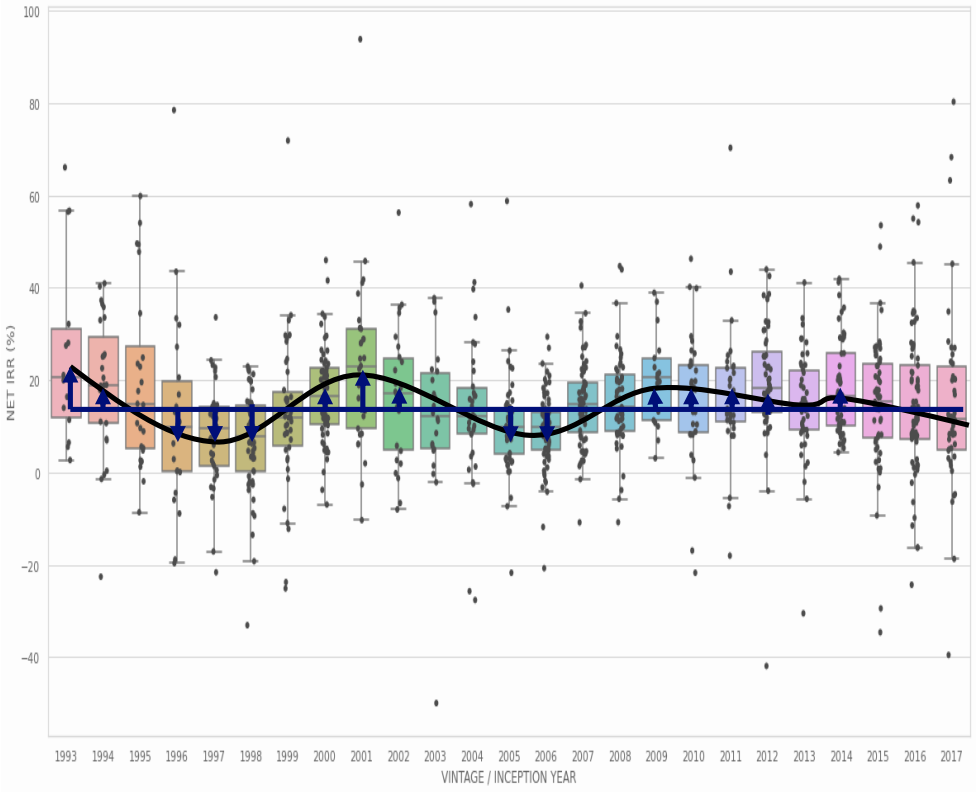


Source: NRI, based on Preqin Pro data on North American buyout funds

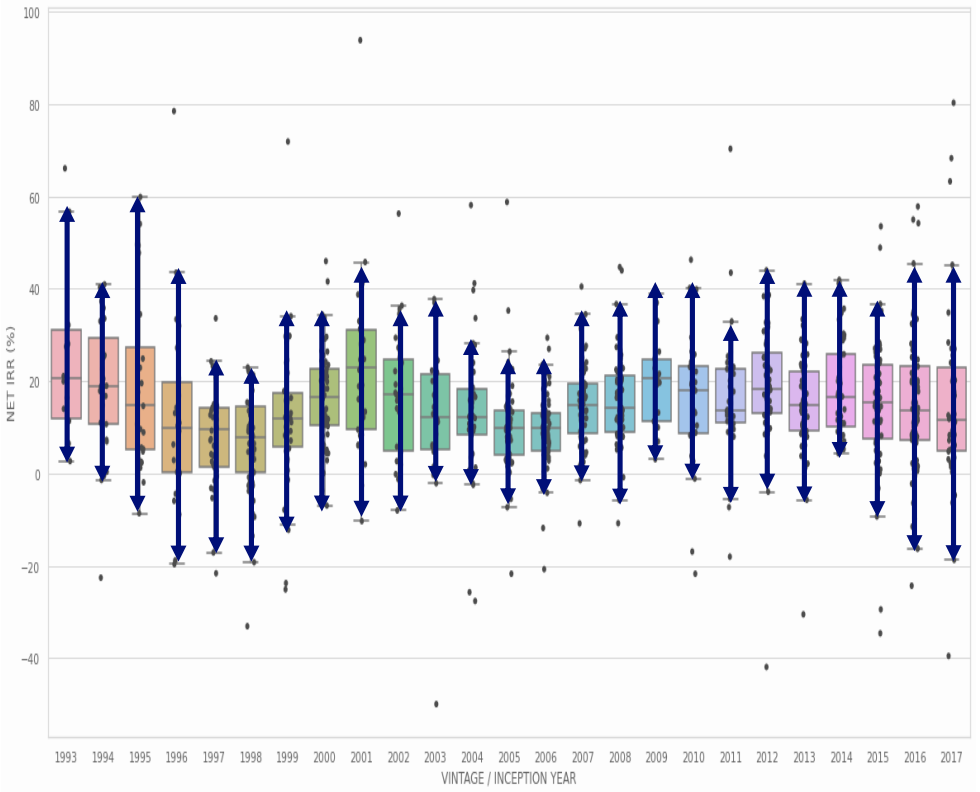
Cross-sectional volatility (reference)

- Cross-sectional volatility (CSV), also know as return dispersion, is a measure of dispersion of returns among, e.g., stocks or same-vintage funds.
  - As CSV increases (decreases), portfolio diversification increases (decreases) but so does fund/stock selection risk.

Regular time-series volatility



Cross-sectional volatility



Source: NRI, based on Preqin Pro data on North American buyout funds

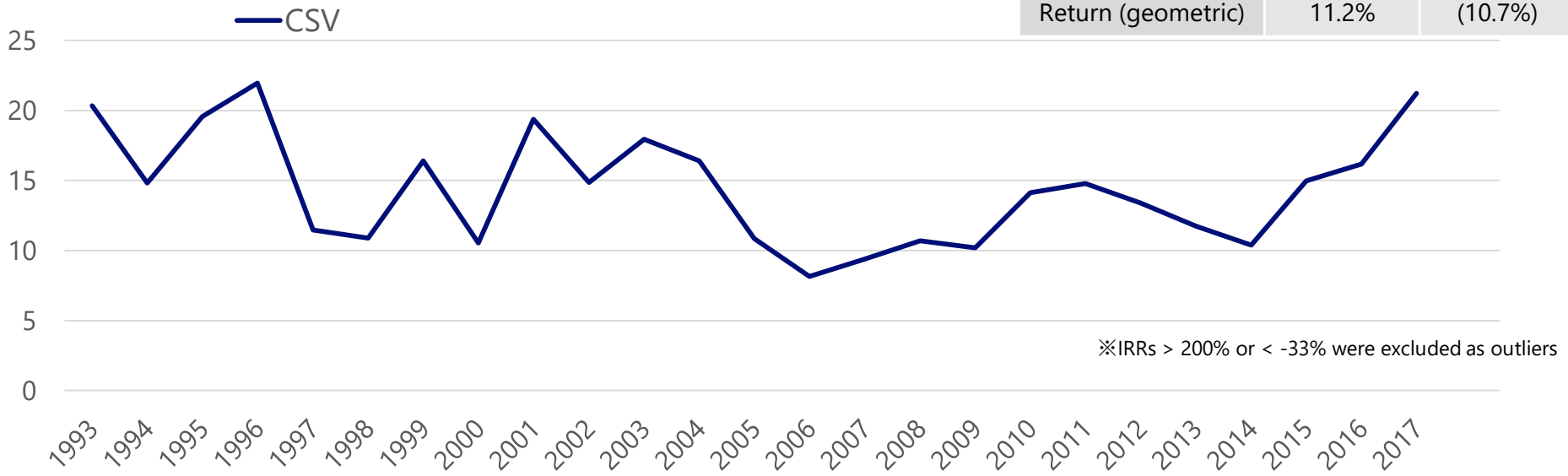
CSV analysis of PE market (1993-2017 vintage funds)

- CSV of same-vintage PE funds' returns averaged 17.4% p.a. for vintage years 1993-2017.
  - Within a vintage-year cohort of funds, 67% and 95% of the funds should have annual returns within ±17.4% (1σ) and ±34.8% (2σ) of the cohort's mean return, respectively. (PE fund returns average ~10-13% p.a.)
- PE returns' CSV is on a par with PE market indexes' time-series volatility of ~18% p.a.

CSV of PE fund returns by vintage year (%)

Preqin Private Capital Quarterly Index (Buyout)

	Preqin	Adjusted
Volatility	8.97%	15.7%
Return (geometric)	11.2%	(10.7%)



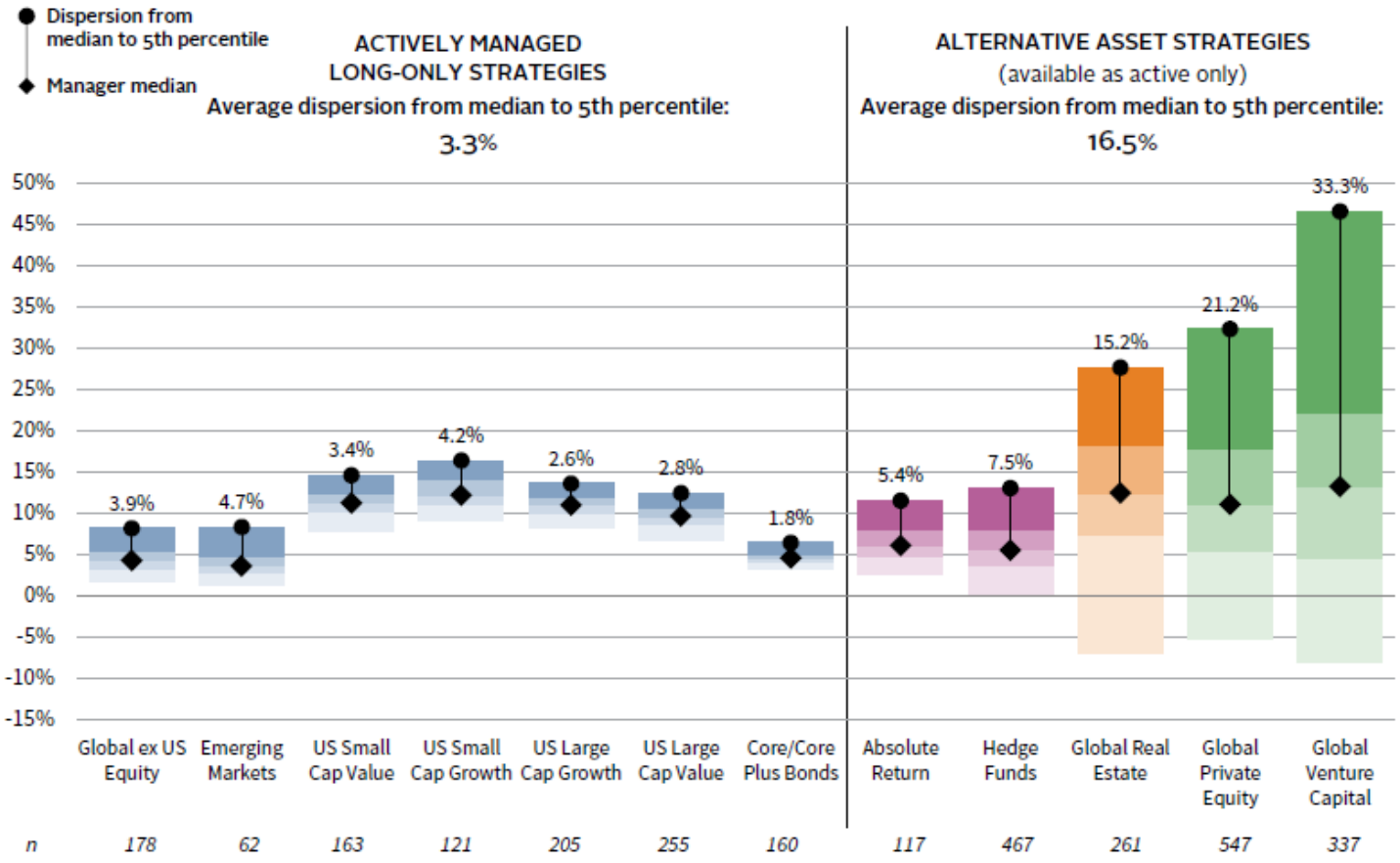
※IRRs > 200% or < -33% were excluded as outliers

Source: NRI, based on Preqin Private Capital Quarterly Index (Buyout) data from Preqin Pro

CSV of returns is higher in PE market than in other asset classes

- While CSV of returns tends to be high across all alternative asset classes, PE's 17.4% CSV is high even within the alt space. Manager-selection skill is crucial.

Fund managers' average annual returns by asset class (July 2008 – June 2018)



Source: https://www.cambridgeassociates.com/insight/private-investing-for-private-investors-life-can-be-better-after-40/

01 Purpose and Background of Study

02 Interview Survey of Outside Experts

03 Data Analyses

04 Summary

Summary

Study findings and takeaways 1

Performance replication

	Interview findings
【Interviews】 Practical applicability	• Alt replication is currently not used much in practice for two main reasons: inconsistent performance and a dearth of replicable return components.
【Interviews】 Peripheral use cases	• Potential peripheral use cases include temporary investment of committed capital awaiting a capital call.
【Analysis】 Public equities' suitability as a replicator	• We found that PE index performance can be tracked with a portfolio of low-EV/EBITDA stocks.

Takeaways

- Our replicating portfolio's simulated performance roughly coincided with a PE index's long-term performance, largely substantiating Hypothesis 1. One benefit of replication is it allows you to rapidly scale up exposure without worrying about illiquidity. Replicator products could be used to deploy capital awaiting a capital call.
- Replication's practical drawbacks per our interviewees include inconsistent performance and insufficient precision to date of replicating high-alpha funds' performance, reaffirming the value of owning real assets.
- Continued efforts, including research, to improve replication techniques' accuracy are well-advised.

Summary

Study findings and takeaways 2

Performance measurement/fees

	Interview findings
【Interviews】 Performance measurement	• Derivative/hybrid models can effectively measure performance if used with awareness of their attributes and drawbacks.
【Interviews】 Issues with fees	• GPs have superior bargaining power due to supply/demand imbalance. LPs need to gain more say.
【Analysis】 Reasonableness of fees	• PE fund fees charged for average returns do not appear out of line with other asset classes.
【Analysis】 Estimation of ex ante returns, risk	• We re-calculated PE indexes' average returns and volatility using unsmoothed data.
【Analysis】 Cross-sectional volatility	• PE has higher CSV of returns than other asset classes. Manager selection skill is key.

Takeaways

- PE management fees look high at first blush but our analysis found that, relative to returns, they are reasonable and not necessarily as high as other asset classes'. Fee issues cited by interviewees include that PE funds charge flat management fee rates irrespective of AUM and charge performance fees even on beta, supporting Hypothesis 2.
- PE has a higher CSV of returns than other assets, both traditional and alternative. This finding affirms that for LPs to earn stable returns, it is important for them to improve their manager selection skills and gain expertise in measuring performance and assessing fees relative thereto.

Summary

Study findings and takeaways 3

Japanese PE market

	Interview findings
【Interviews】 Performance measurement frictions	• Japan lags behind overseas markets in terms of adoption of fair value accounting (FVA).
【Interviews】 Dearth of PE information	• There is a dearth of PE information in Japan. Industry groups have recently started to compile and publish data.
【Interviews】 Market size constraints	• Japan's PE market is smaller than overseas peers but major Japanese companies are actively incubating new businesses through captive VC funds.

Takeaways

- The Japanese PE market currently trails overseas peers in certain respects. Keys to its further development include broad adoption of FVA, expansion of PE data availability and growth in the universe of prospective PE investees.
- For Hypothesis 3, we thoroughly researched performance data and metrics' respective attributes, theoretical bases, interrelationships and availability/usage in Japan vs. overseas. We also learned to use risk quantification and CSV analysis for monitoring alt performance. The next step is figuring out how to practically apply such knowledge to develop better monitoring methods.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