Private Equity in a Broader Portfolio Context

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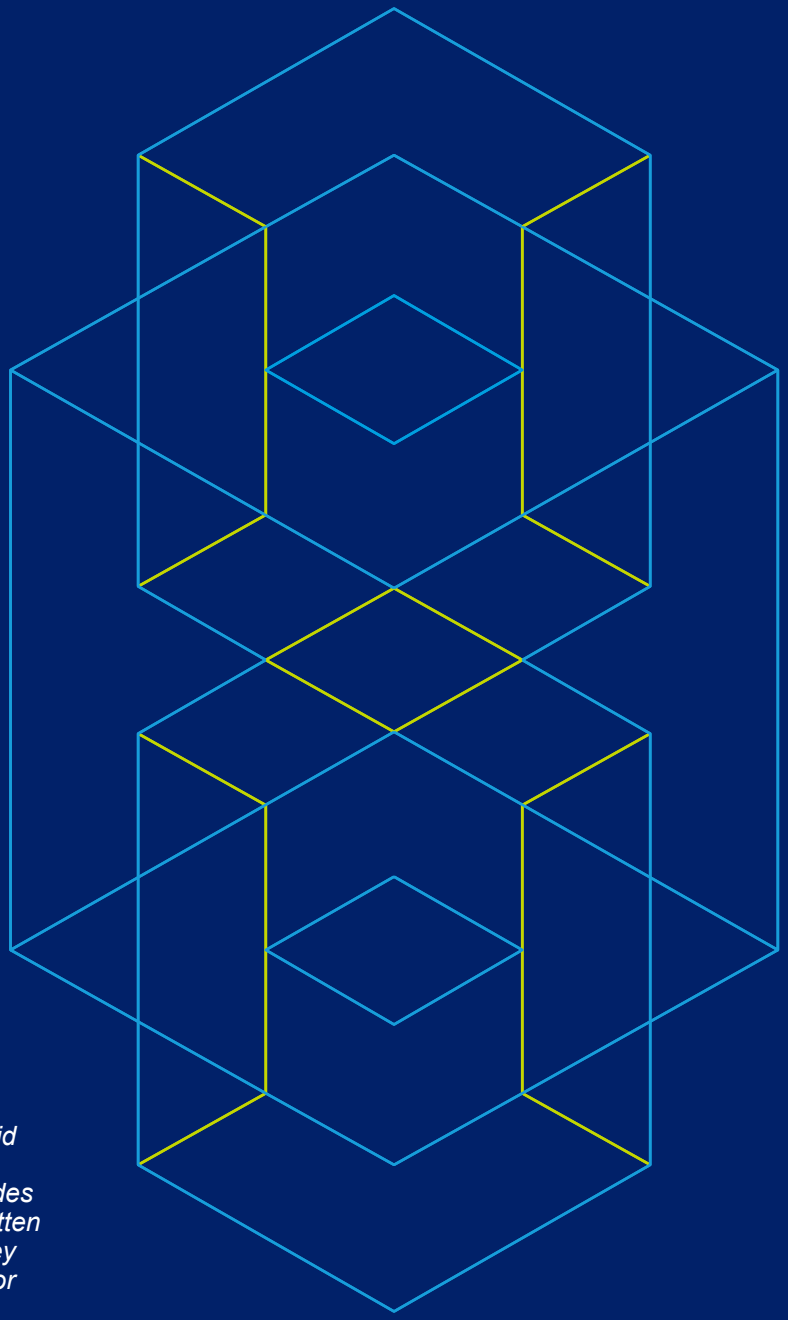

Disclosure: I have limited direct knowledge on PE but I am an avid reader and I have had many discussions with investors and academics about the subject. I could thank several of these besides my colleagues, but instead I highlight my debt to the surveys written for Norway's GPFG – Doskeland-Strömberg (2018) and McKinsey (2017). And I am not alone: these educational surveys are a major public service from Norway and their authors to global investors.

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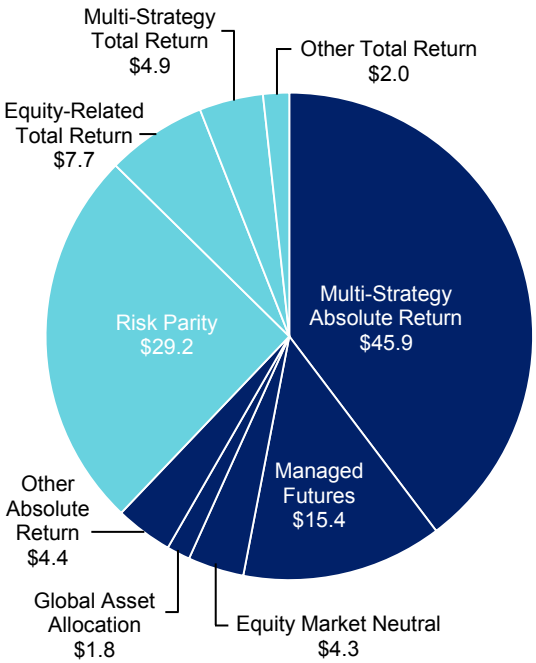
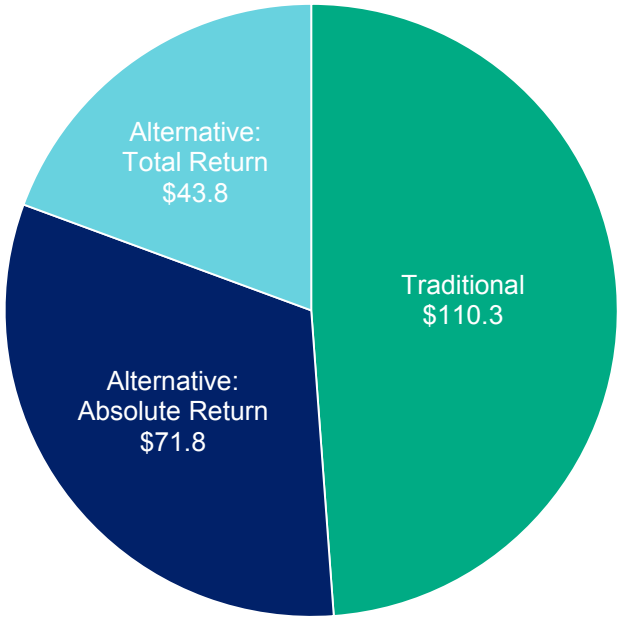
Assets Under Management

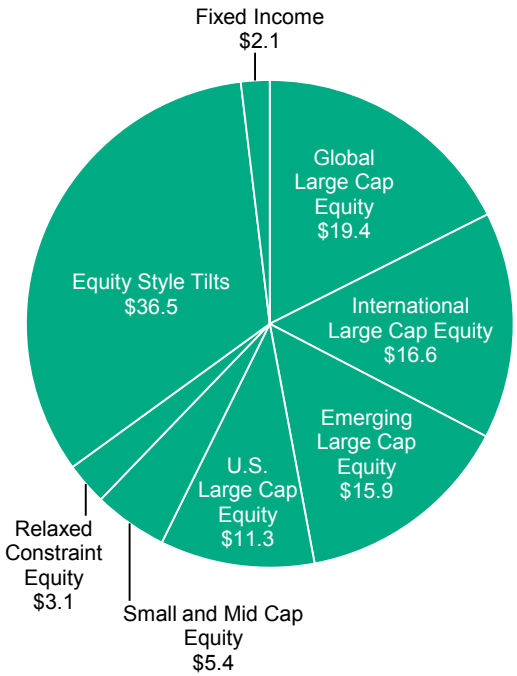
Alternative Investment Assets
$116 Billion*



Total Assets
$226 Billion*



Traditional Strategies
$110 Billion*



*Approximate as of 6/30/2018, includes assets managed by AQR and its advisory affiliates.

Outline

Private equity ("PE") in a broader portfolio context

Overview and caveats

- Describe PE market size … and our focus on only buyouts

Does private equity have an expected return edge over public equity?

- Arguments and evidence for PE industry's positive edge
- How to aim to outperform the industry average
- The counterarguments: fees; future ≠ past; debatable public benchmarks; limited diversification

Understanding PE and its role in a total portfolio

- Quest for common language for public and private
- Do investors overpay for the smoothing service?

Appendices

As noted, this presentation owes a debt to extensive research on PE funds. Important overviews include Doskeland-Strömberg (2018), Kaplan-Strömberg (2009), Kaplan-Sensoy (2015). For critical views, see Phalippou (2011) and Appelbaum-Batt (2016b).

Private Equity Market Size

Up to $2-3 trillion and growing

PE is the majority of *investable* private capital fund markets (total ~$5trn)

'PE' can mean a broad group of PE activities (~$3trn incl. 1/3 dry powder***) or just buyouts (~$2trn)

I will focus on (U.S.) buyouts, the largest and best-performing segment of PE*

Note: buyouts do not include just public-to-private deals; actually private-to-private deals have been more common

Table 3.1: The size of the Private Capital Fund market segments

Fund type	Dry Powder (USD Bn)	Unrealized Value (USD Bn)	Total (USD Bn)
Private Equity (incl. Distress)	1,077.6	2,053.8	3,131.4
Real Estate	245.5	565.4	810.9
Private Debt (excl. Distress)	126.9	208.2	335.0
Infrastructure	149.3	268.4	417.7
Natural Resources	70.9	158.2	229.1
Total	1,670.2	3,254.0	4,924.2

Source: Doskeland-Strömberg (2018). Estimates as of June 2017.

PE Market Segments**	
Buyout	**61%**
Venture Capital	19%
Growth	13%
Distress	5%
Balanced	2%

Source: AQR, Preqin and Doskeland-Strömberg (2018). Estimates as of June 2017.
*Best performance per Preqin fundraising data 2012-17
**Market segment estimates by D-S are based on Preqin data on funds raised 2012-17.
*** "Dry powder" is undrawn capital commitments, or committed uncalled capital, from LPs (investors) to GPs (fund managers). Note that the estimates in D-S Table 3.1 exclude co-investments and direct investments. D-S assess PE co-investments at 310bn and LPs' direct investments at 182bn, small but growing shares in the total PE market. D-S find that as of November 2017 investments into U.S. account for about half of PE capital in recent years, while Europe and Asia account for almost a quarter each. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

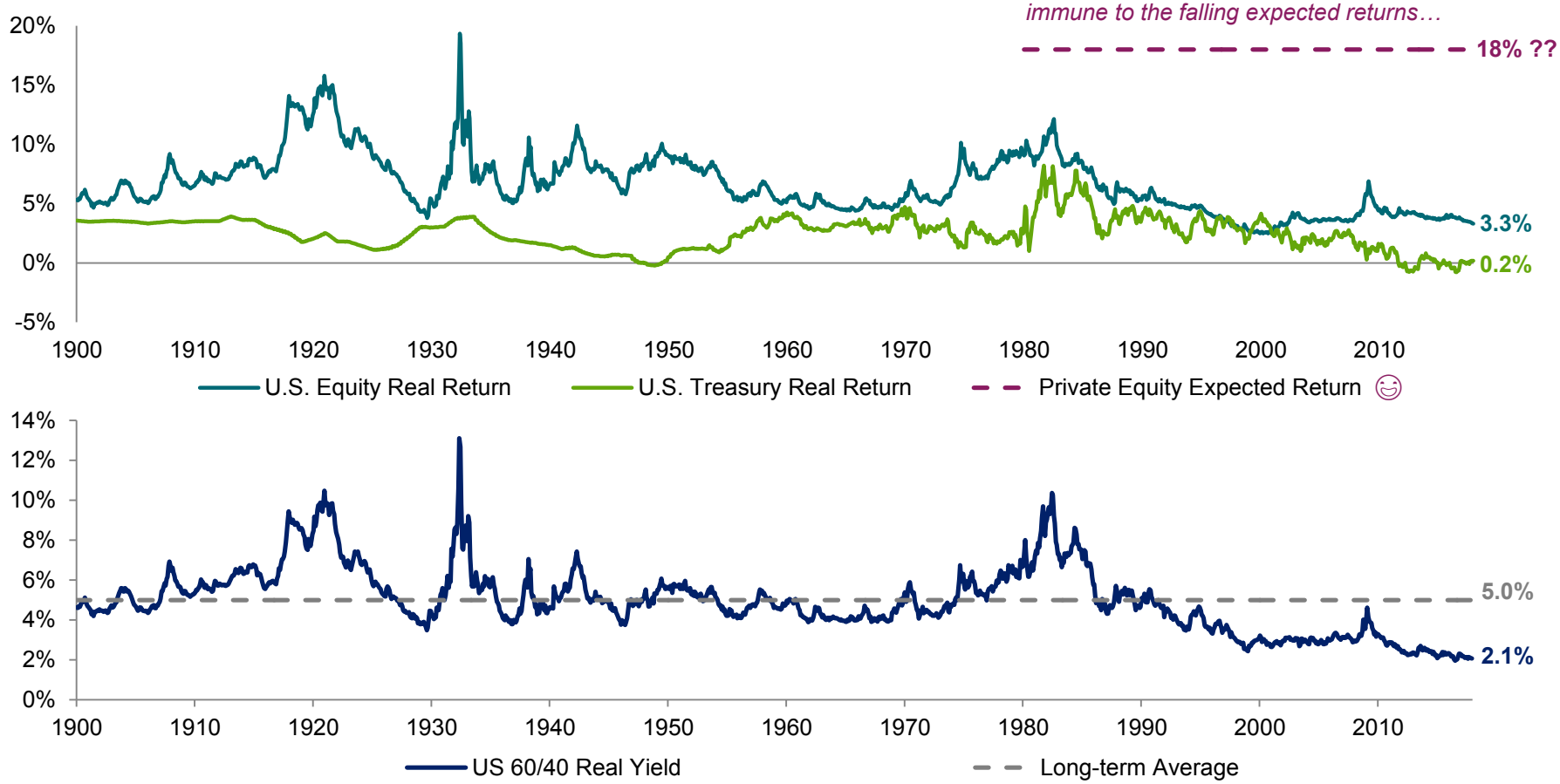
Expected Return of Private Equity

Low Expected Returns Anchor All Long-Only Assets

Prospective real returns are low … even if market yields are not available

Expected Real Yield of U.S. Stocks, Bonds and the 60/40 Portfolio
January 1900–December 2017

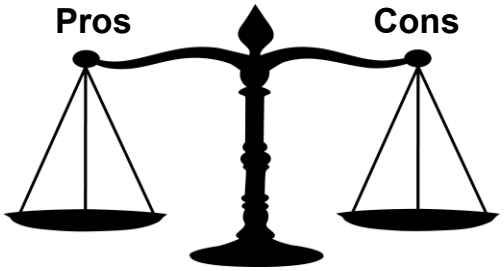
**Some marketing promises of continued high double-digit returns seem to suggest that PE is immune to the falling expected returns…*



*Expected PE return of 18% is illustrative and not representative of AQR's expectations for PE market, see for example: *https://www.economist.com/news/finance-and-economics/21706506-buy-out-firms-are-seeking-out-longer-term-investments-omaha-play*.
Source: AQR, Bloomberg, Robert Shiller's Data Library, Ibbotson Associates (Morningstar), Kozicki-Tinsley (2006), Federal Reserve Bank of Philadelphia, Blue Chip Economic Indicators, Consensus Economics. U.S. 60/40 is 60% U.S. stocks represented by the Standard&Poor's 500 Index and 40% long-dated Treasuries represented by 10-year Treasuries. The equity yield is a 50/50 mix of two measures: 50% Shiller E/P * 1.075 and 50% Dividend/Price + 1.5%. U.S. bond yield is 10-year real Treasury Yield over 10-year inflation forecast. Scalars are used to account for long term real Earnings Per Share (EPS) Growth. Chart is for illustrative purposes only. Please read important disclosures in the Appendix. There is no guarantee, express or implied, that long-term return targets will be achieved. Realized returns may come in higher or lower than expected.

Summary of Positive and Negative Arguments on Private Equity

Weighing the pros and cons of PE over public equity

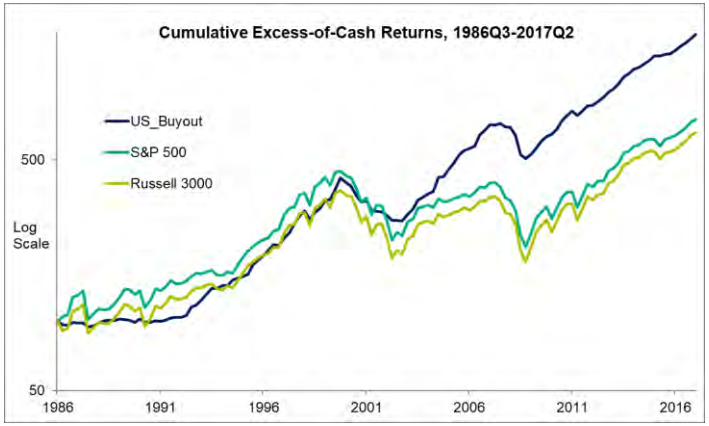


- Theoretical reasons for return enhancement
- Empirical evidence of outperformance over 30yrs
- Easier way to take risk – optical diversifier
- PE *industry* performance is just a base to build on*

- High fees offset: Testing the limits of 'the Asness law'
- Past 10+ years may be a foretaste of a weaker future
- Is S&P500 the right benchmark to PE?
- Overoptimism and/or Overpaying

Net verdict: ?

…but for many, one chart will suffice:



Source: Cambridge Associates, Bloomberg. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

Source: AQR, Cambridge Associates (IRR-based PE "returns" for U.S. Buyout), scales figure from Jessica Broome Research. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

* This is a common aspiration or even expectation, even though we believe most PE investors should anchor their expectations near the industry mean. Our empirics focus on the industry mean.

Pro 1: Theoretical Reasons for a Return Edge

Growing the pie?

Here I liberally borrow from the excellent Doskeland-Strömberg 2018 survey (DS 2018)

Why *should* investors require higher returns for PE?

(1) Illiquidity premia, (2) Maybe higher loadings on market and other factors, (3) PE-specific risk

How *do* PE firms earn above-market returns (and cover their fees)?

- DS 2018 refers to PE model's edges as an organizational form*
- PE investors strive to "create real value through active ownership and governance of firms in a way that is difficult to replicate in a public setting"
- More specifically, Kaplan and Strömberg (2009) emphasize three types of "engineering" that PE investors apply to their portfolio companies in order to increase value:
  - **Governance engineering** (possible because PE investors own a controlling stake)
  - **Financial engineering** (leverage used to finance the acquisitions; incentive benefits and tax benefits)
  - **Operational engineering** (industry and operating expertise that PE investors use to add value)

Source: Doskeland-Stromberg (2018). Please read important disclosures in the Appendix.
* As outlined by Michael Jensen in 1980s. "Jensen (1989) predicted that the PE model would become a dominant corporate organizational form. He argued that the PE investment model combined concentrated ownership stakes in portfolio companies, high-powered incentives for the private equity firm professionals, and a lean, efficient organization with minimal overhead costs. The private equity firm then applied performance-based managerial compensation, optimization of the capital structure, and active governance to the companies in which it invested. According to Jensen, these structures were superior to those of the typical public corporation with dispersed shareholders, low leverage, and weak corporate governance."

Pro 2: Empirical Evidence of PE Outperformance Over 30 Years

The PE industry average has clearly outperformed public equities

- Buyout industry average has outpaced public equities (S&P500) by 2-3% p.a. over 30 years using IRR-based "returns", net of fees
- Right columns in the table include some popular PE proxies beyond S&P500

Performance of U.S. Private and Public Equity
1986-2017 (excess-of-cash returns)

	Cambridge PE (U.S. Buyout)	Cambridge PE (US Buyout) Desmoothed	S&P 500	Russell 3000	1.3 x Russell 3000	Small Value Stocks (FF)
Avg (AM)	9.8%	9.8%	7.8%	7.5%	9.7%	11.4%
Avg (GM)	9.7%	9.1%	6.7%	6.3%	7.6%	9.3%
Volatility	9.3%	13.9%	15.8%	16.4%	21.3%	21.6%
Sharpe	1.05	0.71	0.50	0.46	0.46	0.53
Eqty Corr.	0.70	0.73	0.98	1.00	1.00	0.83
Eqty Beta	0.40	0.62	0.95	1.00	1.30	1.09
AutoCorr1	0.38	-0.06	0.03	0.01	0.01	-0.01

Source: AQR, Bloomberg, Cambridge Associates (using IRR-based raw index returns and an AR(1)-desmoothed variant), Kenneth French Data Library. Risk-free rate for Sharpe calculation is 3M T-bills. Past performance is not a guarantee of future performance. Please read important disclosure in the Appendix.

- A better metric, PME or public market equivalent*, points to 20% higher average net return than S&P500 over the fund life
- PME 1.20 converts to 3-4% annual "direct alpha" – if use effective fund life of 5-6 years**
- Main gains came from PE fund vintages 1996-2005

Buyout PMEs

	All (S&P 500)	US (S&P 500) (N=708)	Europe (MSCI Eur) (N=282)
Average	1.20	1.20	1.21
2000s	1.23	1.20	1.16
1990s	1.23	1.20	1.30
1980s	1.16	1.16	-

Source: Harris et al. (2016). Past performance is not a guarantee of future performance. For illustrative purposes only. Please read important disclosure in the Appendix.

Source: AQR, Bloomberg, Cambridge Associates (using IRR-based raw index returns and an AR(1)-desmoothed variant), Kenneth French Data Library (Small Value Stocks).
* PME is computed as in Kaplan-Schoar (2005): Both capital calls and distributions are discounted using the returns from a public equity benchmark index, such as S&P 500. The PME is then calculated as the ratio between the sum of discounted distributions and the sum of discounted calls. The numerator captures the amount of wealth that an investor would have obtained for an investment in the PE fund, while the denominator captures the amount of wealth that would have resulted from a mimicking strategy where the investor buys the benchmark index at the same times and amounts as the capital calls of the fund. Intuitively, PME above(/below) one implies PE out(/under)performance versus the chosen public-market benchmark. For problems with IRR-based returns, see Phalippou (2011).
** Most literature converts the PME into an annualized alpha based on an effective average fund life of 5-6 years, half the typical legal life of 10(+) years (logic: the committed cash is on average drawn and invested a few years after cash commitments are made, and then returned gradually). Appelbaum-Batt (2016b) question this approach, arguing that if investors commit the cash for the full legal fund life, the full 10 years should be used in annualization, in which case a PME of 1.20 converts to annualized alpha of 1.8%, instead of 3-4%. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

Pro 3: An Easier Way to Take Risk – Optical Diversifier

Diversifying ability depends crucially on use of smoothed returns

Moderate expected correlation to public equities, and lower volatility, based on PE index 'returns'…

…**but** higher from de-smoothed PE returns (or with lagged betas)…and even higher if based on public proxies

Welch (2017) concludes that traditional valuation methods understate the correlation of PE (vs. public equity), creating an illusion of diversification, while new valuation practices reveal greater correlation

- Growing institutional awareness of this issue: Average correlation assumption has risen from 0.4 in 2000 to 0.8 in 2015*
- Many investors recognize overstated diversification benefits, but still value return smoothing**

Our takeaways:

- It is *easier to take risk* when mark-to-market (MTM) fluctuations are smoothed, and leverage is embedded
- One of the main potential benefits of PE is that *it allows investors to take more equity risk and earn more equity premium* than if all MTM fluctuations were visible***, and if all leverage was subject to prime broker calls
  - This applies to all illiquid private assets, not just PE

Source: AQR, Welch (2017). Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix. Diversification does not eliminate the risk of experiencing investment losses. Welch (2017) available at: *https://www.researchgate.net/publication/272304991_Private_Equity's_Diversification_Illusion_Economic_Comovement_and_Fair_Value_Reporting.*
* Exhibit 2 in Welch (2017) tracks the forward-looking correlation assumption between public and private equity across 17 allocation consultants, 6 pensions and 2 endowments.
The ongoing shift from smooth IRR and appraisal based estimates to more volatile estimates initiated from the LP (end-investor) side and likely reflects many developments, including revised fair value standards such as IAS 39; the academic use of PMEs instead of IRRs; literature on other alternatives about the understated volatility and beta estimates due to return smoothing; and end-investors' desire to analyze their total portfolio more consistently in common terms.
** Welch quotesYale's David Swensen: "Not only does lack of day-to-day [MTM] valuation information reduce reported risk [volatility] levels, the private company [also] gains spurious diversifying characteristics based solely on lack of co-movement with the more frequently valued public company."
*** Yet, not all MTM fluctuations are temporary. Smoothing will not help when both public and private equity disappoint over a multi-decade window (cf. Japan post-1990 experience).

Pro 4: PE Industry Performance Is Just a Base to Build On

Many investors expect *their* PE investments to outperform the average

Many investors aspire to identify in advance *and* access those famous top-quartile managers

- Optimism may reflect overconfidence, made worse by opacity and slow feedback/learning in PE
- And why not let everyone outperform? … Diverse evaluation metrics allow half of all PE funds to call themselves top-quartile!*

Plausible ways to "beat the PE market" for a large investor are highlighted in Doskeland-Strömberg (2018):

- Manager selection: performance persistence and wide dispersion give hope, but they have weakened
- Contrarian timing: PE returns have been lower after hot-vintage years characterized by high fundraising activity, high valuations, cheap financing, and high leverage**
- Cost reduction: fee negotiations, secondaries (provide liquidity in bad times), co-investments (hoping to avoid adverse selection; literature is mixed), direct investing (but need costly resources)***

Source: AQR, Doskeland-Strömberg (2018), Kaplan-Strömberg (2009), Axelson et al. (2013), Harris et al. (2014), Robinson-Sensoy (2015), L'Her et al. (2016). Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
* Harris-Stücke (2012).
** Kaplan-Strömberg (2009), Axelson et al. (2013), Harris et al. (2014), Robinson-Sensoy (2015), L'Her et al. (2016).
*** Doskeland-Strömberg (2018) estimate that secondary volume, while growing, was still 'only' ($)42bn in 2014 (double the 2008 peak). For perspective, the total PE market size including dry powder was estimated to be over 3100bn in 2017, on top of which they count 310bn co-investments and almost 200bn direct LP investments. DS pp 103-6 survey tells that research on the relative performance of co-investments shows mixed results, while direct investments and co-investments have earned roughly similar net-of-fee returns as PE funds.

Con 1: Fees Could Offset PE Industry's Return Edge

The PE industry is testing the limits of 'the Asness Law'

"Asness' Law": No investment product is so good that there's not a high enough fee to make it a bad investment

PE fees are famously high and opaque, but institutional investor pressure and new research have slowly begun to improve transparency

Management fees, performance fees, additional portfolio company fees (partly shared with LPs) are inherently difficult to translate into total annual fees, also given the different fees for commitment vs. deployment periods

One recent estimate: almost 6% total annual fees*

- 2.7% management fees**
- 1.9% performance fees (carried interest)
- 1.2% other fees, incl. net portfolio company fees

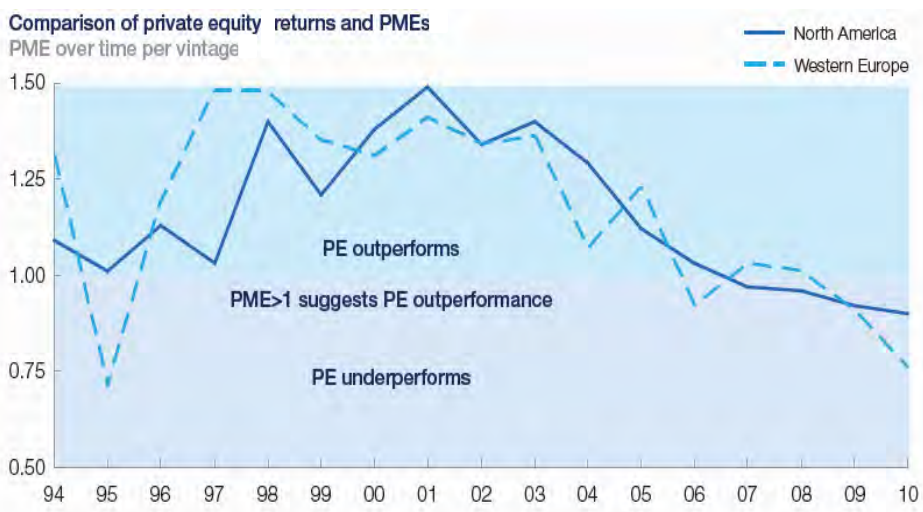
Historically positive industry performance even net of these high fees tells that there is skill or other premium in PE – the question is how much is passed on to the end-investors

Source: McKinsey (2017), Doskeland-Strömberg (2018), and critical views in Appelbaum-Batt (2016a) and Phalippou-Rauch-Umber (2017). For illustrative purposes only. Pease read important disclosures in the Appendix.
* CEM Benchmarking estimate the total annual fee to average 5.7% for a sample of PE funds (including fund investments and fund-of-fund investments), shown in Exhibit 9 of McKinsey (2017). Number of observations: partnership expenses: 112 observations, management fees: 167 observations, carried interest: 84 observations and internal oversight and selection: 122 observations.
** Note that fees are typically based on committed capital for the first six years of the LP-GP agreement, and on NAV for the remaining six years, which is why the management fee can exceed the standard 2% when based on fund NAV in the denominator. Please read important disclosures in the appendix.

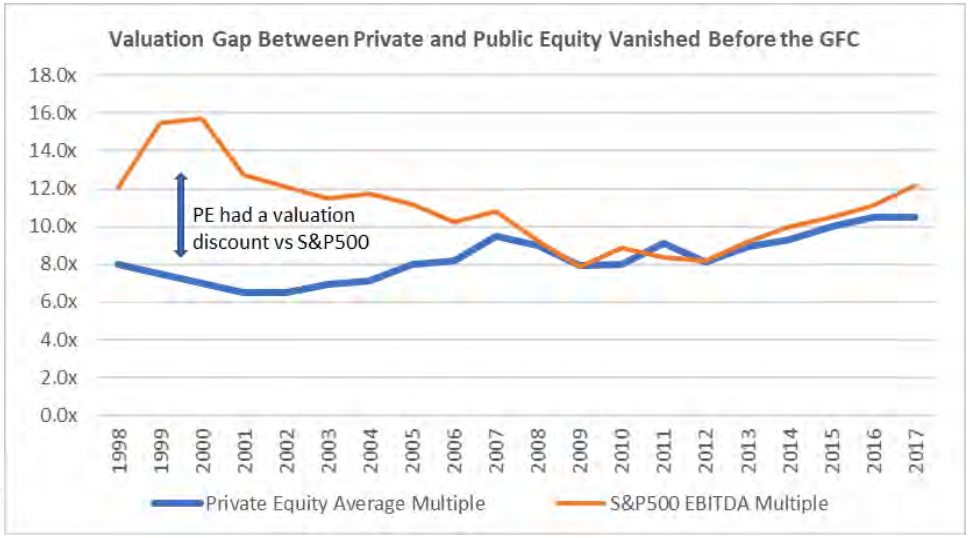
Con 2: Empirically Weaker PE Outperformance Since Mid-2000s

Is this a foretaste of worse performance to come?

- PE industry has *not* outperformed S&P 500 since 2006 (PMEs near 1 – Harris et al. (2014, 2016), L'Her et al. (2016), and Pitchbook data agree on this)
- PE outperformance ended just around the time when the PE market's valuation discount was closed
- As noted, hot vintage years are followed by lower returns
- Competitive environment today is even tougher given institutional demand for PE, more PE firms, record-high dry powder, and competition for deals from cash-rich public companies and SWFs



Source: Harris etal (2016) based on Burgiss data. Past performance is not a guarantee of future performance. Please read important disclosure in the Appendix.



Source: Rasmussen (2018) based on data from Pitchbook, Cambridge Associates, CapitalIQ. Data from 1998-2017. In early years, the author uses proprietary data, for the past decade, Pitchbook data, reflecting calendar-year average information of all PE deal valuations managers assess and report of their private holdings. Past performance is not a guarantee of future performance. Please read important disclosure in the Appendix.

Source: Doskeland-Strömberg (2018), "SWFs" refers to Sovereign Wealth Funds. Note that the LHS chart shows results only up to the 2010 vintage to avoid possibly understated returns for fresh vintages (so-called J-curve effect). By convention, funds are classified to a vintage year by the first capital call. While the chart shows results from Harris et al. (2016), we note that it reflects the consensus from many studies using different PE databases (e.g, see Harris et al (2014), Kaplan-Sensoy (2015), Doskeland-Strömberg (2018)) The old consensus on long-run PE edge was more modest before 2011 when some errors were found in one major database on 1990s PE performance. PME is computed as in Kaplan-Schoar (2005): Both capital calls and distributions are discounted using the returns from a public equity benchmark index, such as S&P 500. The PME is then calculated as the ratio between the sum of discounted distributions and the sum of discounted calls. The numerator captures the amount of wealth that an investor would have obtained for an investment in the PE fund, while the denominator captures the amount of wealth that would have resulted from a mimicking strategy where the investor buys the benchmark index at the same times and amounts as the capital calls of the fund. Intuitively, PME above(/below) one implies PE out(/under)performance versus the chosen public-market benchmark. For problems with IRR-based returns, see Phalippou (2011). Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

Con 3: Is S&P500 the Right Benchmark to PE?

Can we replicate PE's edge with factor/characteristic tilts in public markets?

- Even if we trust the long-run edge of 3-4%* over S&P500, one can ask if S&P500 is the right comparison
- Harris et al. (2016) show that the edge appears robust to benchmark, fund weighting, decade and region
- However, L'Her et al. (2016) argue that adjusting for lower cap and higher leverage removes the PE edge

Buyout PMEs (Harris et al.)

	Average across vintages	Average across sample	Median across sample
S&P 500	1.20	1.18	1.09
Small stocks (Russell 2000)	1.23	1.16	1.03
Small value (Russell 2K value)	1.17	1.08	1.01
Beta 1.5	1.20	1.20	1.07

Source: Harris, Jenkinson, and Kaplan (2016). Past performance is not a guarantee of future performance. For illustrative purposes only. Please read important disclosure in the Appendix.

Buyout PMEs (L'Her et al.)

	Unadjusted S&P 500	S&P Size-Adjusted S&P 600	Levered Size- and Leverage-Adjusted S&P 600	Leverage Size-, Sector-, and Leverage-Adjusted S&P 600 with Buyout Sector Weights
EW average 1986-2014	1.18	1.12	1.04	1.06
VW average 1986-2014	1.12	1.03	0.96	0.94

Source: L'Her et al (2016) based on Burgiss data. "EW" and "VW" averages are equally weighted and value-weighted respectively. Caveat: Recent vintages may have insufficient data by publication time. But the results are similar if 2008 is used as the last vintage. Past performance is not a guarantee of future performance. For illustrative purposes only. Please read important disclosure in the Appendix

- Other studies claim that the PE edge can be at least partly replicated by tilts in listed equity (Phalippou (2014), Stafford (2016), Ang et al. (2017))

Source: Capital IQ, L'Her et al (2016) based on Burgiss data; Harris, Jenkinson, and Kaplan (2016). Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix. To generate the levered size- and sector-adjusted return time series, L'Her et al (2016) first estimated the unlevered return time series and then re-levered the return with the appropriate leverage and cost of the debt. Using data from LCD, L'Herr measured the net-debt-to-enterprise value of buyout investments at inception. LCD does not provide pre-1992 leverage data; L'Herr backfilled the data to 1986, assuming that the leverage was the same then as in 1992. For the sector-adjusted S&P 600, L'Her measured ND/EV from Worldscope data. L'Herr proxied the cost of leverage for buyout investments by the yield of the S&P/LSTA US Leveraged Loan Index, obtained from LCD starting in 1999. For 1992–1999, L'Her used the yield of the US Credit Suisse Leveraged Loan Index. For 1986–1992, L'Herr used as a proxy Barclays BB/B Bond Index minus the average credit spread to the S&P/LSTA US Leveraged Loan Index over 1999–2012. The cost of leverage for public equity is proxied by the yield of the Barclays US Corporate Investment Grade Index.
* See slide 9, PME 1.20 converts to 3-4% annual "direct alpha".

Con 4: Overoptimism and/or Overpaying

Is a slimmer return edge accepted by investors?

End-investors may require at least 3% outperformance from PE as a fair reward for illiquidity and risk*

The industry has not delivered this since mid-2000s, yet end-investors have increased their allocations

Why?

Are investors overoptimistic about PE industry performance, or their own manager selection skills?

- Opacity of the PE market may contribute: limited data; slow feedback; gameable performance measures; reporting biases**

Or, do they accept slimmer excess returns because smooth PE returns understate the volatility and overstate the diversification benefits?

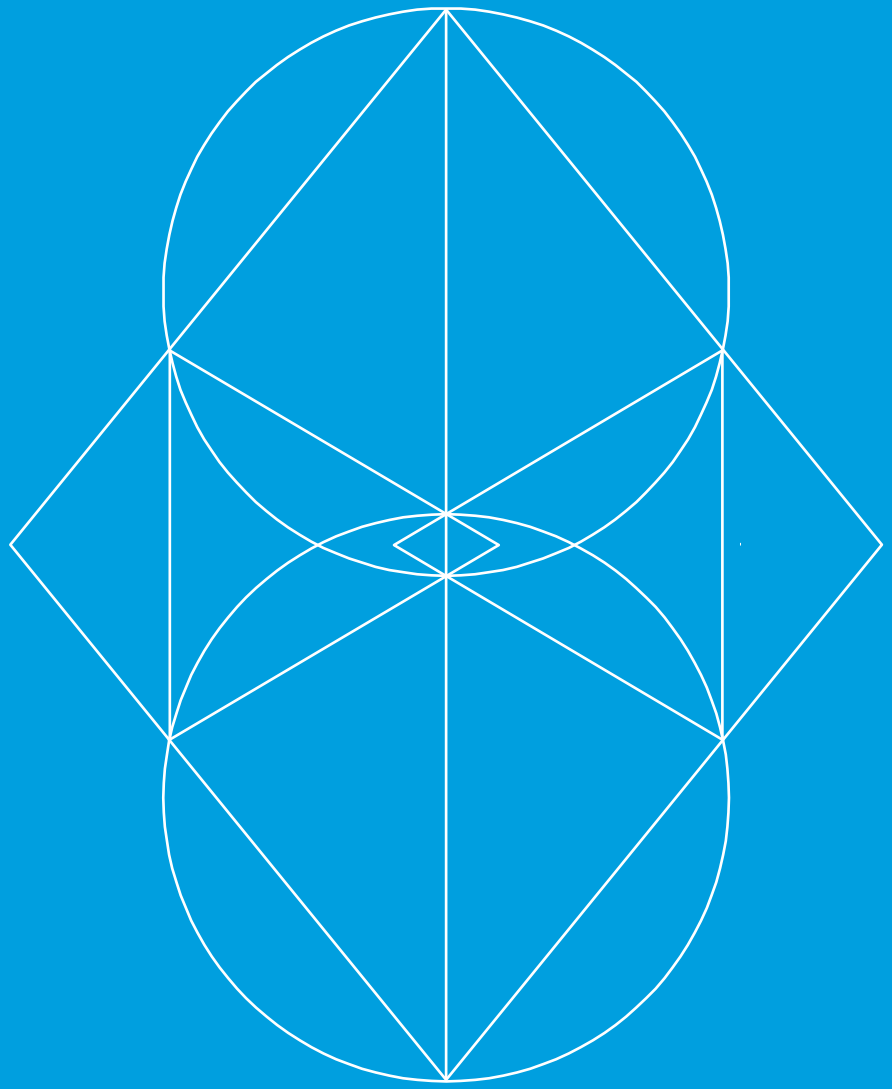
- Overpaying for smoothing may well offset some of the fair illiquidity premium and other premia*** in private assets
- This would follow if investors give some weight in portfolio allocations to understated risk measures, as appears likely****

It's hard to tell, but some combination of the two seems likely

A more positive interpretation: The disappointing performance reflects just small samples or a J-curve effect. We may still expect the 3% outperformance over the long run…

Source: AQR, Andonov-Rauh (2017), Appelbaum-Batt (2016b), Welch (2017). Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
* Appelbaum-Batt (2016b, p.31) list several large U.S. public pension plans who use 3% over public equity as their PE benchmark, while Andonov-Rauh (2017) show that the median long-run return edge of PE over public equity expected by U.S. public pension plans is about 2%.
** Reporting biases may be limited because most databases (Burgiss, Cambridge, Preqin, Pitchbook) source histories from LPs through voluntary reporting or FOIA requests. The consistency of main results across sources is also comforting.
*** Another risk related to illiquidity is the *commitment risk*: the timing of capital calls and distributions depends on the GP, which imposes a call on the whole LP's liquidity and complicates its total portfolio management (but this risk may be mitigated by fund diversification). Robinson-Sensoy (2015) show that net cash flows to LPs are procyclic, Drawing liquidity from LPs in bad times should warrant an illiquidity premium but this timing does help the performance of PE funds in both time-series and cross-sectional sense: Cash commitments by LPs are typically made in even hotter times than cash deployment by GPs, while funds with high propensity to call capital in bad times have had a relatively better performance.
**** See Welch (2017).

Better Understanding PE Returns and Risk in the Wider Portfolio



Better Understanding of PE Returns

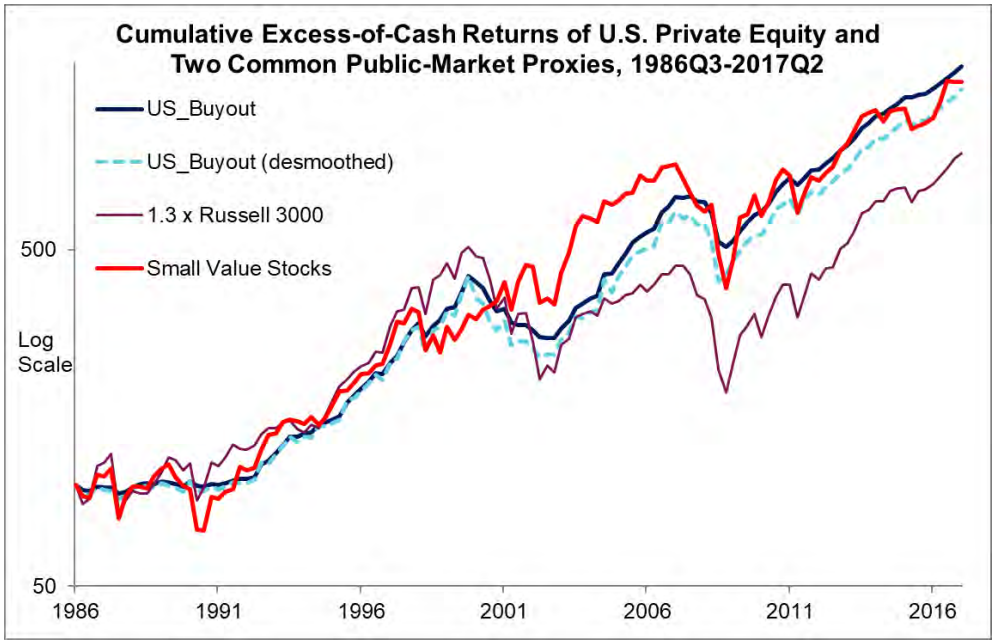
Understanding total portfolio return sources in a common language

Deal-specific PE proxies – often called the "Canada Pension Plan model"*

- Each deal is matched to public-market assets with similar industry and country exposures, and estimated leverage is captured by a short bond position
- This "total portfolio approach" helps institutions view public and private investments in a common language

Public-market proxies for the broad PE industry

- The PE (buyout) industry is increasingly proxied by small-cap stocks or 1.3 beta equity indices



Source: AQR, Bloomberg, Cambridge Associates (using IRR-based raw index returns and an AR(1)-desmoothed variant), Kenneth French Data Library. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

Sources for graph: AQR, Cambridge Associates, Kenneth French Data Library. For illustrative purposes only. 'US_Buyout' returns are Cambridge Associates U.S. Buyout series and 'Small Value Stocks' are small high book-to-market returns from Kenneth French's Data Library. For illustrative purposes only. Please read important disclosures in the Appendix. Past performance is not a guarantee of future performance.
* See Ang et al. (2014).

Better Understanding of PE Returns (cont.)

Demystifying or replicating PE returns

Many studies are trying to demystify and replicate PE industry's performance in a similar vein as public-asset investors' performance has been demystified with factor regressions (cf. Appendix)

- PE managers are not keen on such demystifying efforts
- Clearly, *all* of the PE edge is not replicable with public assets (cf. operational and governance gains on p9, or the smoothing feature). Style tilts, market timing* and sector rotation might be.
- But given the 6%** fees in PE, even partial replication could be enough

However, style factor exposures are hard to detect in PE given the sparse data available on private deals, so empirical results are quite mixed

- The table below summarizes regression-based estimates of U.S. buyout factor sensitivities: few non-market tilts are statistically significant at 5% level^
- Studies using other methods – Phalippou (2014), Stafford (2016), Andreeva (2017) – find strong tilts toward small-cap and value, while L'Her et al. (2016) find small-cap tilt but no value tilt.***

	Market Beta	Small (SMB)	Value (HML)	Illiq. (P-S)
Franzoni et al. (2012)	1.0-1.3	insignif	signif	signif
Driessen et al. (2013)	1.3-1.7	insignif	insignif	n.a.
Ang et al. (2017) buyout	1.2-1.3	insignif	insignif	signif
D-S (2018) LPX50 buyout	1.2-1.4	insignif	signif	insignif

Source: McKinsey (2017), Doskeland-Strömberg (2018). For illustrative purposes only. Please read important disclosures in the Appendix.
* See Jenkinson et al. (2018) on PE managers' market timing skills. **CEM Benchmarking estimate the total annual fee to average 5.7% for a sample of PE funds (including fund investments and fund-of-fund investments), shown in Exhibit 9 of McKinsey (2017). Number of observations: partnership expenses: 112 observations, management fees: 167 observations, carried interest: 84 observations and internal oversight and selection: 122 observations. ***The PE/buyout return series are created using different data sources and universes as well as different methods to convert PE data to return-like series (e.g., some use gross returns of individual PE deals, others use net cash flows to PE funds, while Stafford covers just public-to-private deals, and LPX listed stocks of buyout firms, etc.) ^The following factor models are used to calculate the US buyout factor sensitivities: the CAPM, the three factor models of Fama and French (1993), and the four factor model of Pastor and Stambaugh (2003). Franzoni et al. (2012) uses a dataset provided by the Center for Private Equity Research (CEPRES GmbH), Driessen et al. (2013) uses 272 BO Funds from TVE, D-S (2018) uses the LPX50 Index, and Ang et al. (2017) uses 423 BO funds from Preqin.

Overpaying for the "Smoothing Service"

May explain slim realized and expected return edge of private over public

Investors prefer smooth sailing to a bumpy ride

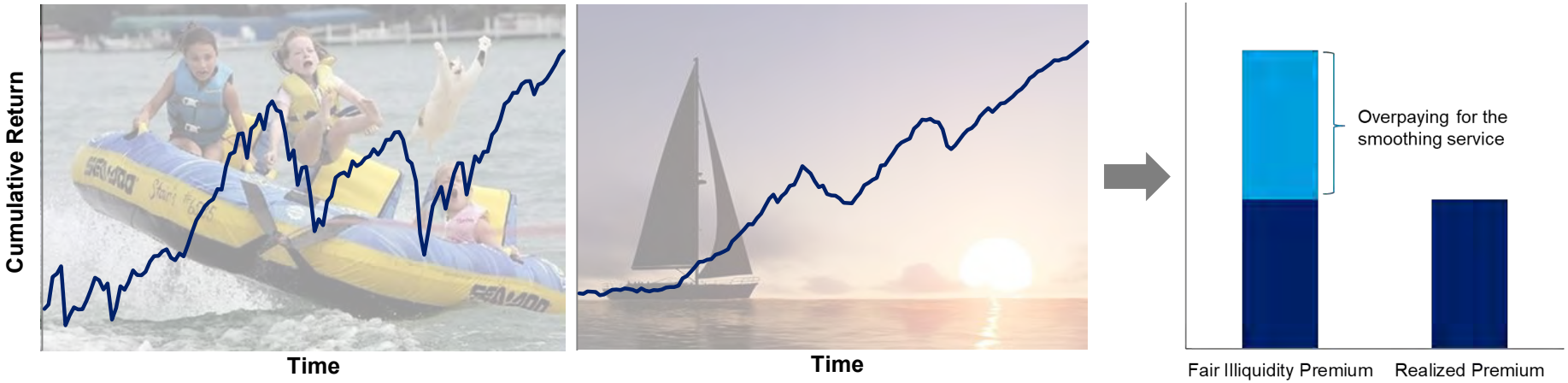


Image source: https://stockboardasset.com/insights-and-research/2018-bumpy-ride-energy-stocks/. For illustrative purposes only.

Image source: http://www.refreshleadership.com/index.php/2015/07/anchor-companys-future-smoothsailing-tips/. For illustrative purposes only.

Overpaying for the smoothing service may offset some of the fair illiquidity premium in private assets

- This would follow if investors give some weight in portfolio allocations to the understated risk measures (see "diversification illusion" in Welch (2017))
- Investors may know that measured PE risks are understated, yet care about them due to regulatory or accounting reasons, e.g., because they smooth needed pension contributions
- Or investors with self-knowledge may deem that it is easier to be patient with equity risk when all the MTM losses do not hit at once => PE may thus enable larger total equity allocations – and potentially enhance long-run returns through "more equity premium" rather than through a large illiquidity premium

Source: AQR, Welch (2017). For illustrative purposes only. Please read important disclosures in the Appendix.

Concluding Remarks

PE's role depends on perspective: smooth or de-smoothed returns

Return enhancer – but overpaying for the smoothing service may mean that less than 3% return edge

Even IF we believe that PE offers 3% edge over public equity, this may imply 1% or 5% CAPM alpha – depending on the weight given to the smooth raw PE returns

It matters whether PE outperformance is deemed "just beta": if the investor portfolio is already dominated by equity risk, other less-correlated alpha sources may be more valuable than PE

Using smooth returns will make PE appear like a valuable diversifier, so much so that constraints must be imposed in portfolio optimization exercises

Using de-smoothed returns will make PE a less attractive diversifier; it can offer other potential benefits:

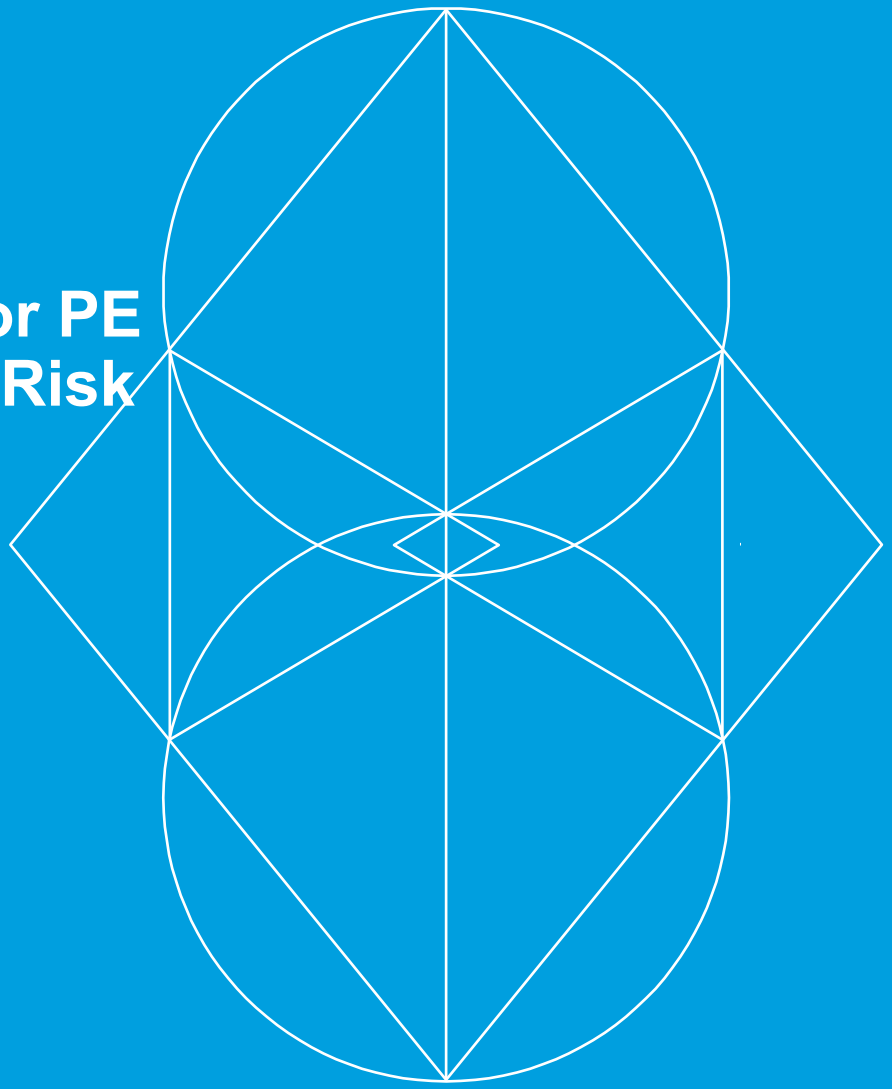
- a modest expected return edge over public equity
- embedded leverage
- high-capacity access to small value
- a smoothing service enables you to hold more equities and earn more equity premium

AQR

Source: AQR. Please read important disclosures in the Appendix.

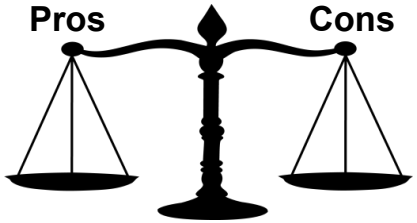
Appendices

- Expected Return Modeling for PE
- More on PE Market Size and Risk
- Demystifying Regressions
- Macro Sensitivities
- References



Summary of Positive and Negative Arguments on Private Equity

Any verdict is inevitably subjective



- Theoretical reasons for return enhancement
- Evidence of outperformance over 30 years
- Easier way to take risk – optical diversifier
- Industry performance is just a base to build on

- High fees: testing the limits of 'Asness' Law'
- Past 10+ years may warn of a weaker future
- Is S&P500 the right benchmark to PE?
- Overoptimism and/or overpaying

Net verdict: mild outperformance of PE over (cap-weighted) public equity seems a good base case

- Below-avg. public equity returns + below-avg. PE outperformance = below-avg. PE returns*
- Current valuations and fees could justify especially low estimates for the coming decade
- Besides basing expected returns on historical average returns, theory-based (normative required return) or supply-based approaches are possible. We show below one illustrative example of each.
  - One supply-based approach (in the spirit of the discount cash flow models) considers current market yields as well as private equity valuations, and fees, growth enhancements, leverage
  - One theory-based approach uses CAPM betas and adjusts the expected/required return of comparable public equity for PE's higher risk. (Another theory-based approach (not shown) involves estimating a fair illiquidity premium for forgone flexibility – though this may be offset by investors overpaying for the smoothing service.)

Source: AQR, graph from Jessica Broome Research. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
* Andonov-Rauh (2017) show that the median long-run return edge of PE over public equity expected by 231 U.S. public pension plans between 2014 and 2016 is about 2% (12.1% vs 9.6% arithmetic mean, 10.0% vs. 8.6% geometric mean). The level of these forecasts is high, partly because they reflect multi-decade horizons and embed higher cash and inflation forecasts (3-3.5% mean cash rate and 3% inflation) than appear likely for the coming decade, partly because of pension optimism on equities.

Return Decomposition in PE and Other Asset Classes

Supply-based framework: net income + CF growth + valuation change

Discounted cash flow framework is often used to assess prospective returns in liquid asset markets

Numbers below are only illustrative* as any estimates require many assumptions

Data limitations complicates the task further in PE but the idea is worth exploring

Asset Class	Net Real Income (real return in unchanged cap. mkt. env., incl. fees)	Expected Real CF Growth	Expected Valuation Change	Total Exp. Real LT Return
Public Equity (U.S. cap-wtd)	Div.Yield or Net Payout Yield; *(assume negligible fee)* 2.0 - 2.5%	Real E(DPS) or E(EPS) (use long-term trend) 1.5 - 2.0%	Assume zero 0%	**4%**
Bonds (U.S. 10Y Treasury)	Yield - Exp. Infl. + Rolldown; (*assume negligible fee)* 1%	None 0%	Assume zero 0%	**1%**
Real Estate (NCREIF NPI, *Unlevered*)	Proxy CF Yld w. 2/3 of Cap Ratio (if 1/3 CapEx, then 4.5%x(2/3)=3%); *assume 0.5% fee* 2.5%	Imperfect inflation pass-through -0.5%	Assume zero 0%	**2%**
Private Equity (US Buyout)	Above-mkt yield? Levg. Fee. Say, 3x 3% yield *minus assumed 6% fees* 3%	Above-mkt growth, levg. 3x 3% E(real CF growth) - 2x 3% HY real yld (levg.cost) 3%	Assume zero 0%	**6%**

Source: Ilmanen (2011): Expected Returns; AQR (2018): *Alternative Thinking:* Capital Market Assumptions; Straehl-Ibbotson (2017): The Long-Run Drivers of Stock Returns: Total Payouts and the Real Economy. *Financial Analysts Journal*; Siegel (2018): She Caught the CATY; Pagliari (2017): Some Thoughts on Real Estate Pricing, *Journal of Portfolio Management*.
For illustrative purposes only. Notes: Numbers are for illustration only and not to be taken as current forecasts. Any tax effects are ignored. The naïve takeaway that more and cheaper leverage boosts expected return on PE is inconsistent with empirical evidence that such conditions coincide with hot-vintage years and low prospective returns. Please read important disclosures in the Appendix. Hypothetical performance results have certain inherent limitations, some of which are discussed in the disclosures.
* We use ballpark reasonable estimates that are not too far from *Alternative Thinking 1Q2018* capital market assumptions for stocks and bonds, and in line with the Pagliari (2017) for Real Estate. For Private Equity we assume higher numbers than for public equity, and a leverage estimate from Doskeland-Strömberg (2018). Please see Appendix for *Alternative Thinking 1Q2018* capital market assumptions methodology for stocks and bonds.

One Way to Estimate Private Equity's Expected Return and Risk

Assume same Sharpe ratio as public equity; adjust for beta/leverage

Step 1: Calculate expected return and volatility of Large Cap (LC) U.S. stocks (e.g., based on DDM or cycl.-adj. earnings yield)

	Expected Real Return	Expected Inflation	Exp. Nominal Ret. (Real + Inflation)
LC Stocks	4.0%	2.2%	6.2%

	1. Past 10-year Volatility	2. Long-Term Vol (Since 1990)	Expected Volatility (Avg of 1 and 2)
LC Stocks	15.0%	14.2%	14.6%

Step 2: Assuming small cap (SC) stocks have same risk-adjusted return as LC stocks and using the same volatility forecast methodology, calculate the expected excess return of SC stocks

	1. Past 10-year Volatility	2. Volatility Since 1990	Expected Volatility (Avg of 1 and 2)
SC Stocks	19.8%	18.7%	19.2%

	LC Stocks
Excess Return*	4.0%
Volatility of ExR	14.2%
Sharpe Ratio	0.27

	Sharpe Ratio	Volatility	Expected Excess Return (Sharpe Ratio * Vol)
SC Stocks	0.27	19.2%	5.3%

Step 3: Employ 1.2x market beta** to estimate the expected excess return and volatility of PE

	SC Stocks			Private Equity
Excess Return	5.3%	x 1.2	=	6.3%
Volatility	19.2%	x 1.2	=	23.1%
Sharpe Ratio	0.27			0.27

Step 4: Add back cash to give total return forecasts and observe the differences between our estimates

	LC Stocks	SC Stocks	Private Equity
Excess Return	4.0%	5.3%	6.3%
	+	+	+
Cash	2.2%	2.2%	2.2%
	=	=	=
Total Return	6.2%	7.5%	8.5%
PE Return Premium	2.3%	1.1%	--

Source: AQR, Bloomberg, Large Cap Stocks is the S&P 500 and Small Cap Stocks is the Russell 2000, Consensus Economics. For illustrative purposes only. Hypothetical data has certain inherent limitations, some of which are disclosed in the Appendix. Please read important disclosures in the Appendix.
* For U.S. Equities, we average two yield-based approaches: 1. Earnings-based: Shiller E/P * 0.5 (long-run dividend payout ratio) + 1.5% long-run real EPS growth 2. Payout-based: Dividend Yield + Net Buyback Yield + estimated real aggregate payout growth. We assume no mean reversion in equity valuations, and we quote local real returns. We expect the return of cash to be equal to inflation, and thus our expected excess return is equal to our expected real return. See *AQR Alternative Thinking 1Q2018*, 10-Year forecast inflation uses Consensus Economics data. Please see Alternative Thinking slides at the end of this presentation for further information. ** Franzoni, Nowak and Phalippou (2012) estimate a 1.3 beta for PE vs Large-cap companies, attributable to the higher debt-to-equity ratio of PE companies. This 1.3 beta versus large-cap is equivalent to a 1.2 beta versus small-cap.

More Context to Private Equity Market Size

Small but growing share

Investable PE market is $2-3trn…

…compared to $40-70trn global public equity (depending on definitions)

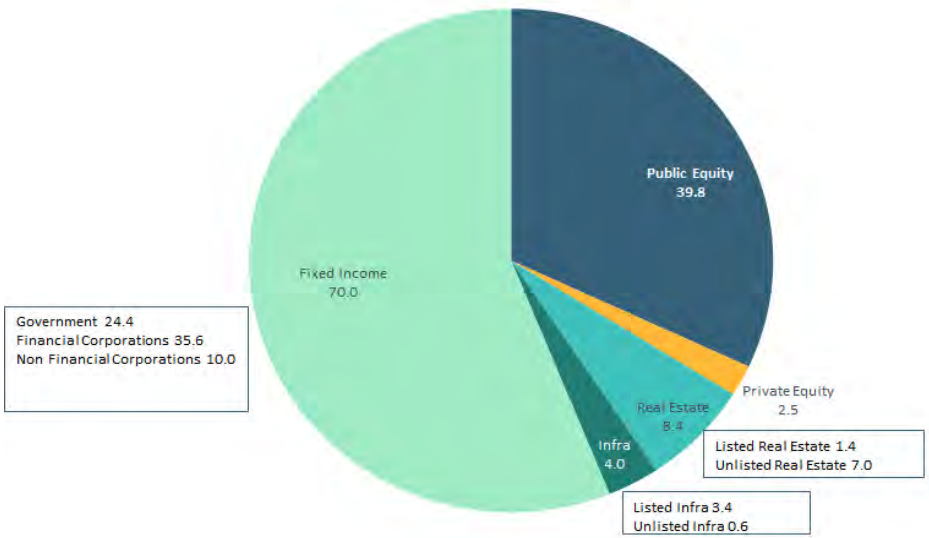
PE market share: ca. 5% of total equity, 2% of global investable wealth, though on a mild uptrend

PE share in institutional portfolios in double-digits for some investor groups

Demand is growing while popularity of hedge funds and traditional active equity is softening

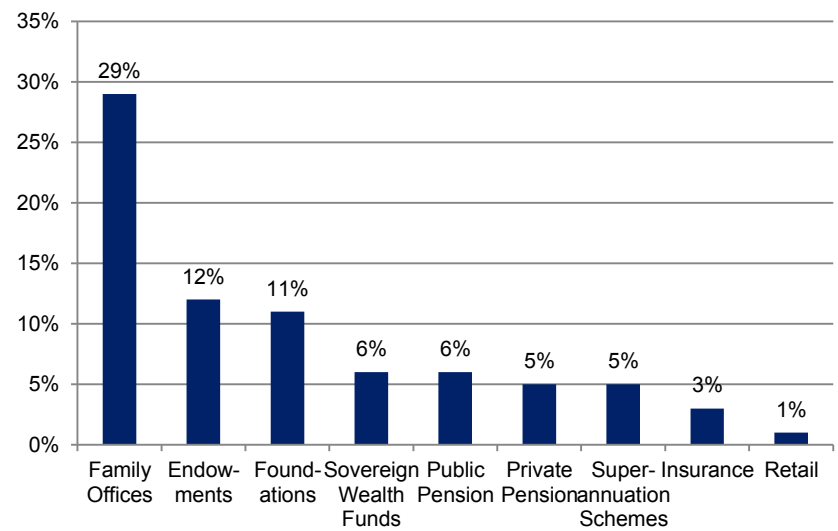
McKinsey (2017) PE allocations for some very large pension plans: Europe 5%, U.S. 10%, Canada 15%

Investable Global Market Portfolio in $ trn, June-2015



Source: Gupta et al. (2016)

Average Private Equity Allocation by Investor Type



Source: Pomona Capital, as of October 2017, using Preqin data. (See: https://individuals.voya.com/system/files/document/file/Pomona%20Capital%20-%20Private%20Equity%20Overview.PDF .)

Source: Gupta et al. (2016) and Pamona Capital. Note that in the piechart on the left, investable real estate and infrastructure markets are judged to be about ten times larger than on the previous page which focused on investable private funds. Estimates of investability in private markets are inherently judgmental. Most uninvestable private markets are much larger than investable ones. Even with public equities, total cap estimates vary a lot. Including smaller equity markets and without float-adjustment, the 2017 global public equity estimates exceed $70trn (and private equity $3trn), see Gupta et al. (2016). McKinsey (2017) findings use Preqin data as of November 2017, the universe is a sample of 12 peer funds, reflecting a mix of pension funds and sovereign wealth funds from North America, Asia, and Europe (including two Scandinavian funds). Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.

Better Understanding of PE Risk

Risk estimate depends crucially on weight given to smooth raw PE returns

Let's be more modest and merely ask about the **basic riskiness (volatility or market beta) of PE**

- Even this is hard
- Is the PE industry volatility 10% or 25%, and is the market beta 0.5 or 1.5 or even 2+?
- Raw PE index returns give single-digit volatility, while de-smoothing may raise it by 50-100%*
- Simple regressions show beta near 0.5, and even with lagged betas below 1*
- Axelson et al. (2014) leverage argument: public equity adds 0.3-0.5x debt on equity, while PE adds 2x**
- Many academic studies above, with varying data/methods, show **PE (buyout) industry beta near 1.3**

Useful way to think of at least three contributions to measured portfolio risks:

- Per-deal risk: especially leverage and size point to high total risk – but measured risk will be reduced by:
  - Smoothing effects
  - Diversification across deals/funds

Source: AQR, DS (2018) and Axelson et al (2014). 'Raw PE Index returns' refers to Cambridge Associates U.S. Buyout data. See slide 10. Past performance is not a guarantee of future performance. Please read important disclosures in the Appendix.
*AQR, Bloomberg, Cambridge Associates (using IRR-based raw index returns and an AR(1)-desmoothed variant), Kenneth French Data Library. Please refer to slide 9.
**Terminology on leverage varies but debt-to-equity 66%/33% split in a buyout implies leverage near 2 or 66% debt-to-enterprise-value ratio. Axelson et al quote even higher beta estimates, using D/EV ratio above 70%. But their beta estimates above 2 are on gross-of-fee returns, and would imply beta below 2 for net-of-fee returns. Axelson et al. (2014) use data from 1994-2013 provided by a large fund-of-funds, one of the world's largest investors in private equity, including both buyout and venture capital funds.

Factor Return Regressions Provide Demystifying Evidence

Help investors understand active managers' long-run return sources

As a group, delegated active managers exhibit highly significant market exposures as well as significant small-cap and pro-momentum tilts (plus high-beta tilts for hedge funds)

Hedge funds, as a group, have been about 80% correlated with equity markets

1999-2016
Mutual Funds
Morningstar DB
All U.S. (eq.wtd.)

6-Factor Regression Statistics			*4-Factor Regr Stat's*
Adj. R Square	98.6%		Adj. R Square
	Coefficient	*t Stat*	*Coefficient*
Intercept	-0.053	-1.36	-0.011
MKT	0.989	99.55	1.006
SMB (Small-Cap)	0.125	10.42	
HMLdev (Value)	0.014	0.69	0.077
UMD (Momentum)	0.053	5.89	0.059
GPOA (Quality)	0.017	0.91	
BAB (Low Risk)	0.008	0.76	-0.037

1999-2016
Hedge Funds
(All CS/HFR avg.)

6-Factor Regression Statistics			*4-Factor Regr*
Adj. R Square	97.8%	64.9%	Adj. R Square
	t Stat	*Coefficient*	*t Stat*	*Coefficient*
Intercept	0.24	0.264	3.54	0.281
MKT	84.55	0.288	15.12	0.298
SMB (Small-Cap)		0.067	2.91	
HMLdev (Value)	4.90	-0.031	-0.82	0.010
UMD (Momentum)	5.49	0.081	4.71	0.086
GPOA (Quality)		-0.003	-0.07	
BAB (Low Risk)	-2.90	-0.048	-2.26	-0.071

Source: AQR, Morningstar, CS, HFR. For the period 1999-2016. For illustrative purposes only. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix. Please read important disclosures at the end of this presentation. MKT is a value-weighted CRSP market portfolio, SMB: Small Minus Big size factor, HMLdev: High Minus Low value factor (based on book-to-market), UMD: Up Minus Down momentum factor (based on performance in the past year, skipping past month), GPOA is gross profit over total assets, BAB (Betting Against Beta) is a levered beta-neutral portfolio that is long low beta stocks and short high beta stocks with the stock universe roughly the Russell 1000.

Demystifying Buffett

Can demystify individual investors as well as manager composites

"Whether we're talking about socks or stocks, I like buying quality merchandise when it is marked down."*

	Average Return	Volatility	Sharpe Ratio	Annual Outperformance	Information Ratio
Berkshire Hathaway	17.6%	23.6%	0.74	10.6%	0.49
U.S. Equities	6.9%	15.5%	0.45	-	-

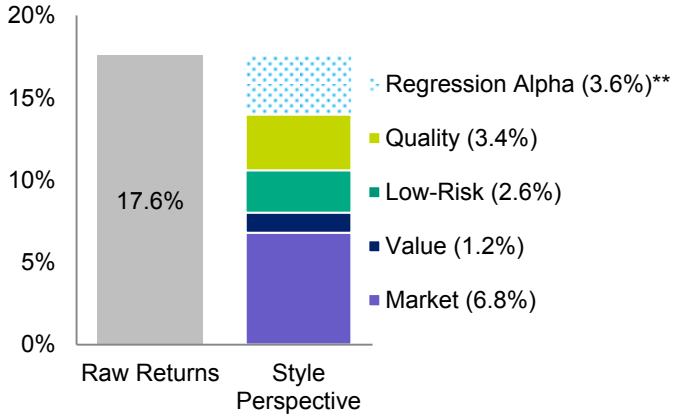
Factors Used

Market: the U.S. equity market factor from Kenneth French's data library
Value: the HML factor from Kenneth French's data library
Low-Risk: the "Betting-Against-Beta" (BAB) factor from AQR's data library
Quality: the "Quality-Minus-Junk" (QMJ) factor from AQR's data library

Regression Statistics

	Alpha (ann'l)	Market	Value	Low-Risk	Quality	R^2
Coefficient	3.6%	0.98	0.43	0.23	0.63	28%
T-stat	1.0	12.4	3.6	2.6	4.6	

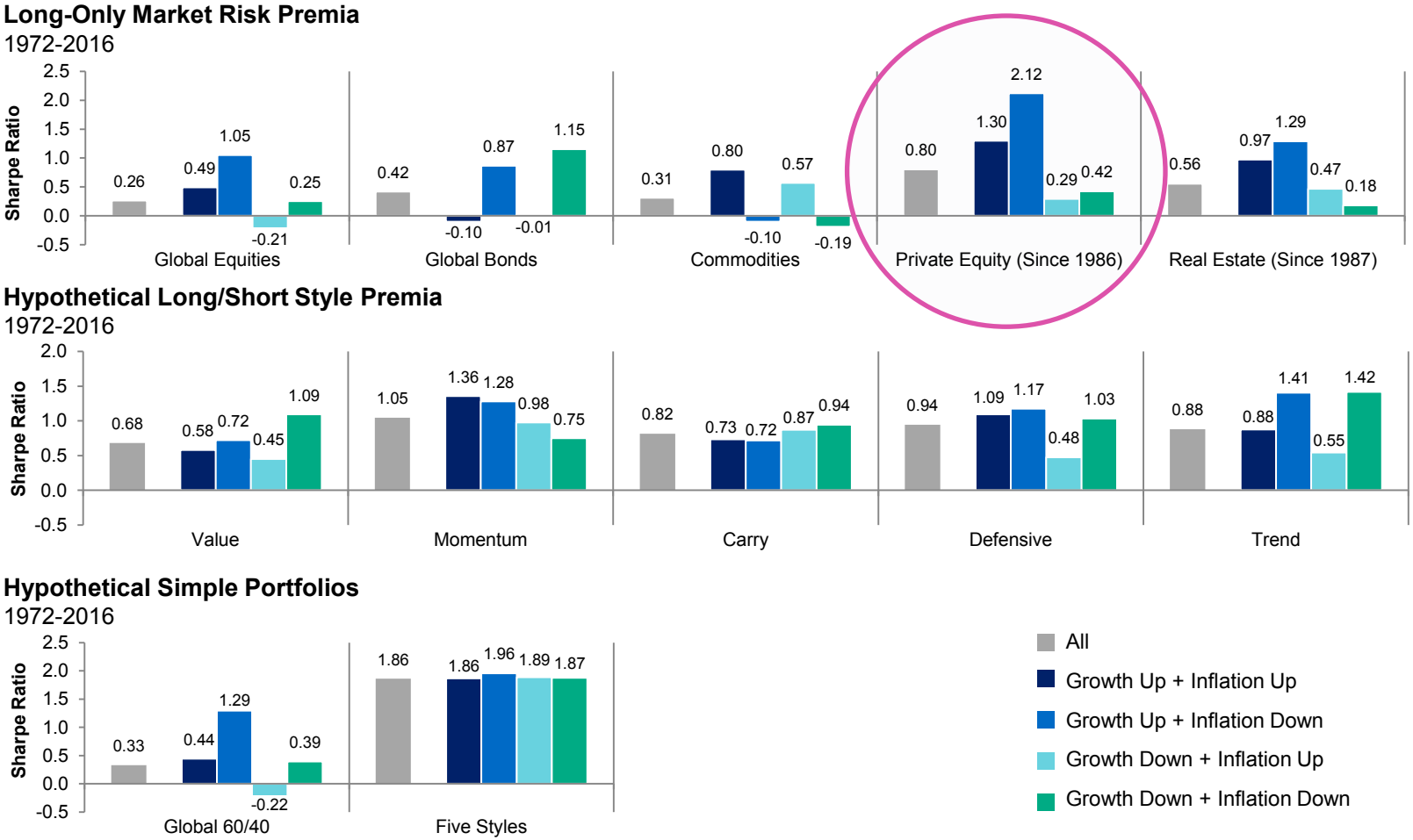
Regression-based Return Attribution



Source: AQR, 4Q2016 Alternative Thinking: Superstar Investors, AQR, CRSP (for BRK data). For inspiration of this superstars-demystifying study, see Frazzini-Kabiller-Pedersen (2012): Buffett's Alpha. Returns in all exhibits are excess of risk-free rate from Kenneth French's data library, unless stated otherwise. Factor returns are all gross of fees and transactions costs. U.S. Equities are the CRSP capitalization-weighted equity market factor from Kenneth French's data library. All data are from Jan 1977 to May 2016. See appendix for details on factor construction.
*Warren Buffett, Berkshire Hathaway Inc., Annual Report, 2008.
**Not statistically significant at 95% confidence.

Assessing Sensitivities To Different Macro Environments

Macro diversification: mapping investments to macro risks



Source: Bloomberg, AQR. Data from January 1972 – December 2016. Global Equities is the MSCI World Index. Global Bonds is a GDP weighted composite of Australian, European, Canadian, Japanese, U.K. and U.S. 10-year government bonds. Commodities is an equal dollar-weighted index of 24 commodities. Private Equity and Real Estate are represented by Cambridge Associates indices. Long-Short Style Premia are backtests of style premia as described herein. Global 60/40 takes 60% Global Equities and 40% Global Bonds. Five Styles is an equal dollar-weighted composite of the five long/short style premia. Please see Appendix for more details on the construction of the return series and macroeconomic environmental indicators. The analysis is based on hypothetical returns gross of trading costs and fees. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix. Past performance is not a guarantee of future performance.

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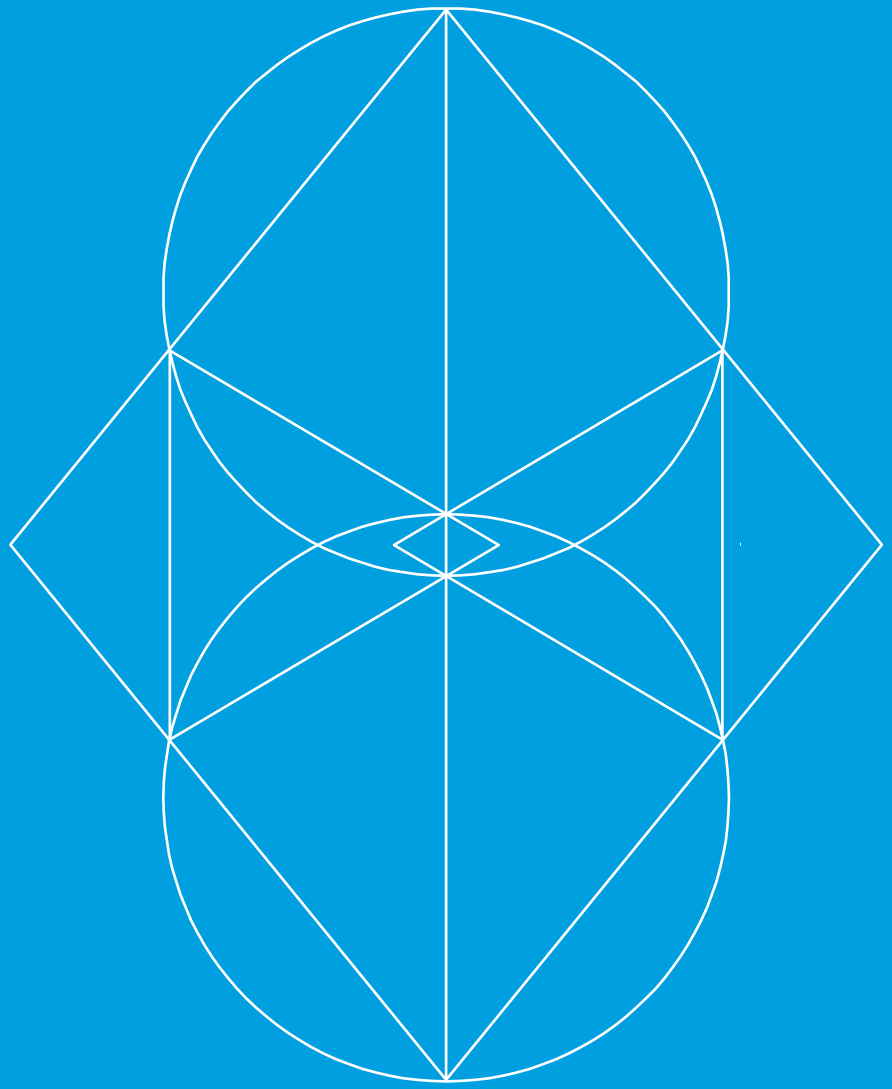
Alternative Thinking Capital Market Assumptions Methodology for Equities and Government Bonds



Equities

Building 5- to 10-Year Local Real Return Estimates

We average two yield-based approaches:

1. Earnings-based: Shiller E/P * 0.5 (long-run dividend payout ratio) + 1.5% long-run real EPS growth
2. Payout-based: Dividend Yield + Net Buyback Yield + estimated real aggregate payout growth

We assume no mean reversion in equity valuations, and we quote local real returns

	1. Earnings-Based	2. Payout-Based	Combined
	$0.5 * E/P + G_{EPS}$	$D/P + NBY + G_{agg}$	Avg (1, 2)
	Earnings-Based Expected Return	Payout-Based Expected Return	Expected Real Equity Return
U.S.	3.4%	4.7%	4.0%
Euro-5	4.1%	4.7%	4.4%
Japan	3.4%	4.0%	3.7%
U.K.	4.5%	5.9%	5.2%
Australia	4.2%	6.2%	5.2%
Global Developed	3.6%	4.7%	4.2%
Emerging Markets	5.5%	4.2%	4.8%

Source: AQR, Consensus Economics and Bloomberg. Return assumptions and methodology are subject to change and based on data as of November 30, 2017. The local real equity expected return is an average of two approaches: 1. The Shiller earnings yield (using 10-year earnings) scaled by 1.075 (embedding an annual real EPS growth of 1.5%), multiplied by 0.5 and added to a real growth rate in EPS of 1.5% for developed countries and 2% for emerging markets. 2. The sum of dividend yield plus estimates of net buyback yield (NBY) and long-term real growth of aggregate payouts, G. G is the average of two measures: (i) long-term historical real earnings growth (since 1970) adjusted for dilution (GP), and (ii) long-term forecast real GDP growth based on Consensus Economics data (GG). GP and GG are both shrunk halfway towards a cross-country average. For earnings yield, U.S. is based on the S&P 500; U.K. on the FTSE 100 Index ; "Euro-5" is a cap-weighted average of large-cap indices in Germany, France, Italy, the Netherlands and Spain; Japan on the Topix Index; and "Emerging Markets" is based on the MSCI Emerging Markets Index. For payout-based estimates, all countries are based on corresponding MSCI indices. "Global Developed" is a cap-weighted average of the developed market estimates.

Government Bonds

Building Local Real Return Estimates for 10-Year Government Bonds

Note that we assume no mean reversion in real bond yields, and we quote local real returns

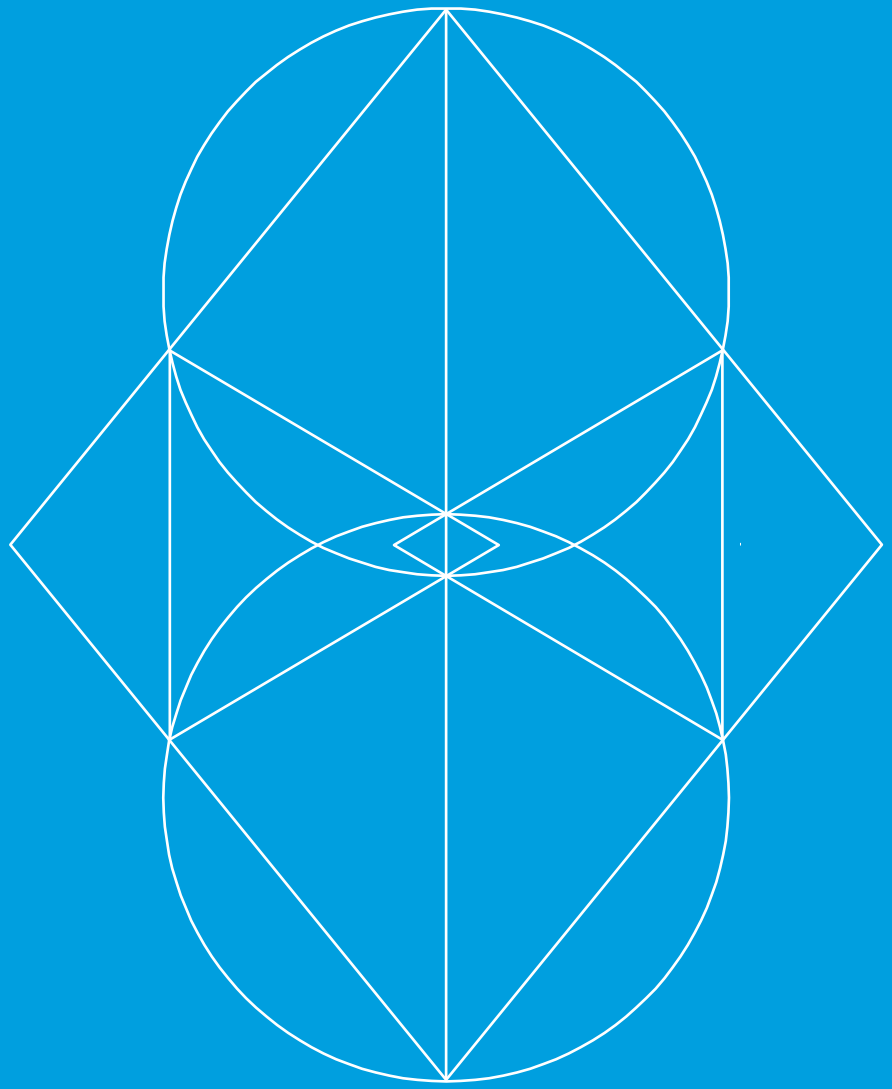
Can investments in very low-yielding bonds be justified? We believe the answer is yes:

- Low bond yields should be considered in the context of exceptionally low cash rates
- Tactical humility is warranted – 2016 proved that even low yields can fall as well as rise
- Bonds remain useful diversifiers for equity-dominated portfolios

	Y	RR	I	Y+RR-I
	10-Year Nominal Bond Yield	Rolldown Return	10-Year Forecast Inflation	Expected Local Real 10Y Bond Return
U.S.	2.4%	0.3%	2.2%	**0.5%**
Japan	0.0%	0.4%	1.1%	**-0.7%**
Germany	0.4%	1.3%	1.7%	**-0.1%**
U.K.	1.3%	0.8%	2.2%	**-0.1%**
Australia	2.5%	0.4%	2.5%	**0.5%**

Source: AQR, Bloomberg and Consensus Economics. Please see AQR Alternative Thinking Q1 2017 for a detailed explanation of our methodology, including how to translate these estimates to USD hedged or unhedged returns. Hypothetical performance results have certain inherent limitations, some of which are disclosed in the Appendix. Rolldown return is estimated from fitted yield curves. Long-term expected inflation is based on data from Consensus Economics. Return assumptions are subject to change and based on data as of Nov 30, 2017.

Disclosures



Performance Disclosures
Building macro indicators

Macro Indicators

We choose to construct macro indicators, or risk factors, mainly based on fundamental economic data, and not based on asset market returns (which are "too close" to the patterns we try to explain). For example, potential market–based proxies of economic growth include equity market returns, the relative performance of cyclical industries, dividend swaps, and estimates from cross–sectional regressions of asset returns on growth surprises. This choice brings its own problems, notably timing challenges as macroeconomic data are backward—looking, published with lags and later revised, while asset prices are clearly forward–looking. The impact of publication lags and the mismatch between backward– and forward–looking perspectives can be mitigated by using longer windows. Thus, we use contemporaneous annual economic data and asset returns through our analysis (past–year data with quarterly overlapping observations). Arguably composite growth surprise indices are the best proxies of economic growth news, but such composites are available at best going back to 1990s. Forecast changes in economist surveys as well as business and consumer confidence surveys may be the next best choices because they are reasonably forward-looking and timely. In a globalized world, it is not clear whether we should focus only on domestic macro developments, but data constraints make us focus on U.S. data. Finally, it is not clear how real economic growth ties to expected corporate cash flow growth (e.g., earnings per share) that influence stock prices or to real yields that influence all asset prices but especially those of bonds.

Each of our macro indicators combines two series, which are first normalized to Z–scores: that is, we subtract a historical mean from each observation and divide by a historical volatility. When we classify our quarterly 12–month periods into, say, 'growth up' and 'growth down' periods, we compare actual observations to the median so as to have an equal number of up and down observations (because we are not trying to create an investable strategy where data should be available for investors in real time, we use the full sample median).

The underlying series for our growth indicator are the Chicago Fed National Activity Index (CFNAI) and the "surprise" in industrial production growth over the past year. Since there is no uniquely correct proxy way to capture "growth"; averaging may make the results more robust and signals appropriate humility. CFNAI takes this averaging idea to extremes as it combines 85 monthly indicators of U.S. economic activity. The other series – the difference between actual annual growth in industrial production and the consensus economist forecast a year earlier – is narrower but more directly captures the surprise effect in economic developments. We use median forecasts from the Survey of Professional Forecasters data as published by the Philadelphia Fed. While data surprises a priori have a zero mean, this series has exhibited a downward trend in recent decades, reflecting the (partly unexpected) relative decline of the U.S. manufacturing sector.

Our inflation indicator is also an average of two normalized series. One series measures the de–trended level of inflation (CPIYOY minus its mean, divided by volatility), while the other measures the surprise element in realized inflation (CPIYOY minus consensus economist forecast a year earlier).

Investment Return Series

The investment return series we study include both asset class premia and style premia. The former are long-only returns but expressed in excess returns over the Treasury bill rate. The latter are long-short returns and scaled to target or realize 10% annual volatility. We subtract no trading costs or fees, which makes a bigger difference for the long-short strategies.

The asset class premia are global equities (MSCI World), global bonds (GDP-weighted average of 10-year government bonds in six countries), and an equal-weighted composite of 24 commodity futures.

The market-neutral style premia (Value, Momentum, Carry and Defensive) are hypothetical long/short strategies applied in multiple asset classes: stock selection, industry allocation, country allocation in equity, fixed income and currency markets, and commodities. Each style premia strategy allocates 50/50 risk weights to stock and industry selection (SS) and asset allocation (AA) strategies. For AA we use the same relative risk weights for asset classes as "Investing With Style" (AQR white paper, 2012, available upon request): 33% equity country allocation, 25% fixed income, 25% currencies, 17% commodities. We combine several data sources to produce a dataset long enough to capture many different macroeconomic environments:

- Since 1990, we use value, momentum, carry and defensive style premia strategies as described in "Investing With Style" (AQR white paper, 2012, available upon request). For SS value, momentum and carry we use 50/50 risk weights between stock selection within industries and across industries (to be in line with the common but arguably inefficient practice of letting across-industry positions matter as much as within-industry positions). For SS carry (not included in the white paper) we use the dividend yield strategy returns in Ken French's data library.
- For 1972-1989, we source value and momentum style returns from "Value and Momentum Everywhere" (Journal of Finance, 2013), defensive style returns from "Betting Against Beta" (Journal of Financial Economics, 2013), and SS carry from the dividend yield strategy returns in Ken French's data library. We construct the AA carry style premia before 1990 as well as some early histories of AA value, momentum and defensive styles using AQR in-house backtests. These backtests are similar to those described above, but over a narrower universe.

While the SS style premia proxies we use since 1990 are beta-neutral, the value and momentum premia before 1990, and the SS carry premium throughout, are 'only' dollar-neutral and may contain moderate empirical beta exposures. The defensive style premia are beta-neutral throughout (we buy larger amounts of low-risk investments than we sell high-risk investments), which means that they are actually not as 'defensive' as a dollar-neutral defensive style.

In addition to the four market-neutral style premia, we include the market-directional Trend style, which applies 12-month trend-following strategies in four asset classes: equities, fixed income, currencies and commodities. While the style is nearly uncorrelated with equity markets in the long run, at any point in time it can be directionally long or short. For data since 1985, we use "Time Series Momentum" (Journal of Financial Economics, 2012). For 1972-1984, we use in-house backtests based on the same asset classes, but including 1-, 3- and 12-month momentum, and starting with a smaller asset universe that grows during the period as more assets become available.

Performance Disclosures
Factor descriptions

Market (as described in Kenneth French's Data Library): Rm-Rf, the excess return on the market, value-weight return of all CRSP firms incorporated in the U.S. and listed on the NYSE, AMEX, or NASDAQ that have a CRSP share code of 10 or 11 at the beginning of month, good shares and price data at the beginning of t, and good return data for t minus the one-month Treasury bill rate (from Ibbotson Associates). See Fama and French, 1993, "Common Risk Factors in the Returns on Stocks and Bonds," Journal of Financial Economics, for a complete description of the factor returns.

Value (as described in Kenneth French's Data Library): HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios, HML = 1/2 (Small Value + Big Value) - 1/2 (Small Growth + Big Growth). HML includes for July of year t to June of t+1 all NYSE, AMEX, and NASDAQ stocks for which we have market equity data for December of t-1 and June of t, and (positive) book equity data for t-1.

Low-Risk: the "Betting-Against-Beta" (BAB) factor from AQR's data library, as defined in Frazzini and Pedersen (2014). BAB factors are portfolios that are long low-beta securities and that short-sell high-beta. To construct each BAB factor, all securities in a country are ranked in ascending order on the basis of their estimated beta and the ranked securities are assigned to one of two portfolios: low-beta and high-beta. In each portfolio, securities are weighted by the ranked betas (lower-beta securities have larger weights in the low-beta portfolio and higher-beta securities have larger weights in the high-beta portfolio). The portfolios are rebalanced every calendar month. To construct the BAB factor, both portfolios are rescaled to have a beta of one at portfolio formation. The BAB is the self-financing zero-beta portfolio that is long the low-beta portfolio and that short-sells the high-beta portfolio

Quality: the "Quality-Minus-Junk" (QMJ) factor from AQR's data library, as defined in Asness, Frazzini and Pedersen (2014). The Quality Score is the average of four aspects of quality: Profitability, Growth, Safety and Payout. We use a broad set of measures to compute each of four aspects of quality; the score for each aspect is the average of the individual z-scores of the underlying measure. Each variable is converted each month into ranks and standardized to obtain the z-score. 1) Profitability is measured by: Gross profits over assets, return on equity, return on assets, cash flow over assets, gross margin, and the fraction of earnings composed of cash. 2) Growth is measured by: The five-year prior growth in profitability, averaged across the measures of profitability. 3) Safety is defined as: Companies with low beta, low idiosyncratic volatility, low leverage, low bankruptcy risk and low ROE volatility. 4) Payout is defined using: Equity and debt net issuance and total net payout over profits. QMJ factors are constructed as the intersection of six value-weighted portfolios formed on size and quality. At the end of each calendar month, we assign stocks to two size-sorted portfolios based on their market capitalization. For U.S. securities, the size breakpoint is the median NYSE market equity. We use conditional sorts, first sorting on size, then on quality. Portfolios are value-weighted, refreshed every calendar month, and rebalanced every calendar month to maintain value weights. The QMJ factor return is the average return on the two high-quality portfolios minus the average return on the two low-quality (junk) portfolios.

Performance Disclosures

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