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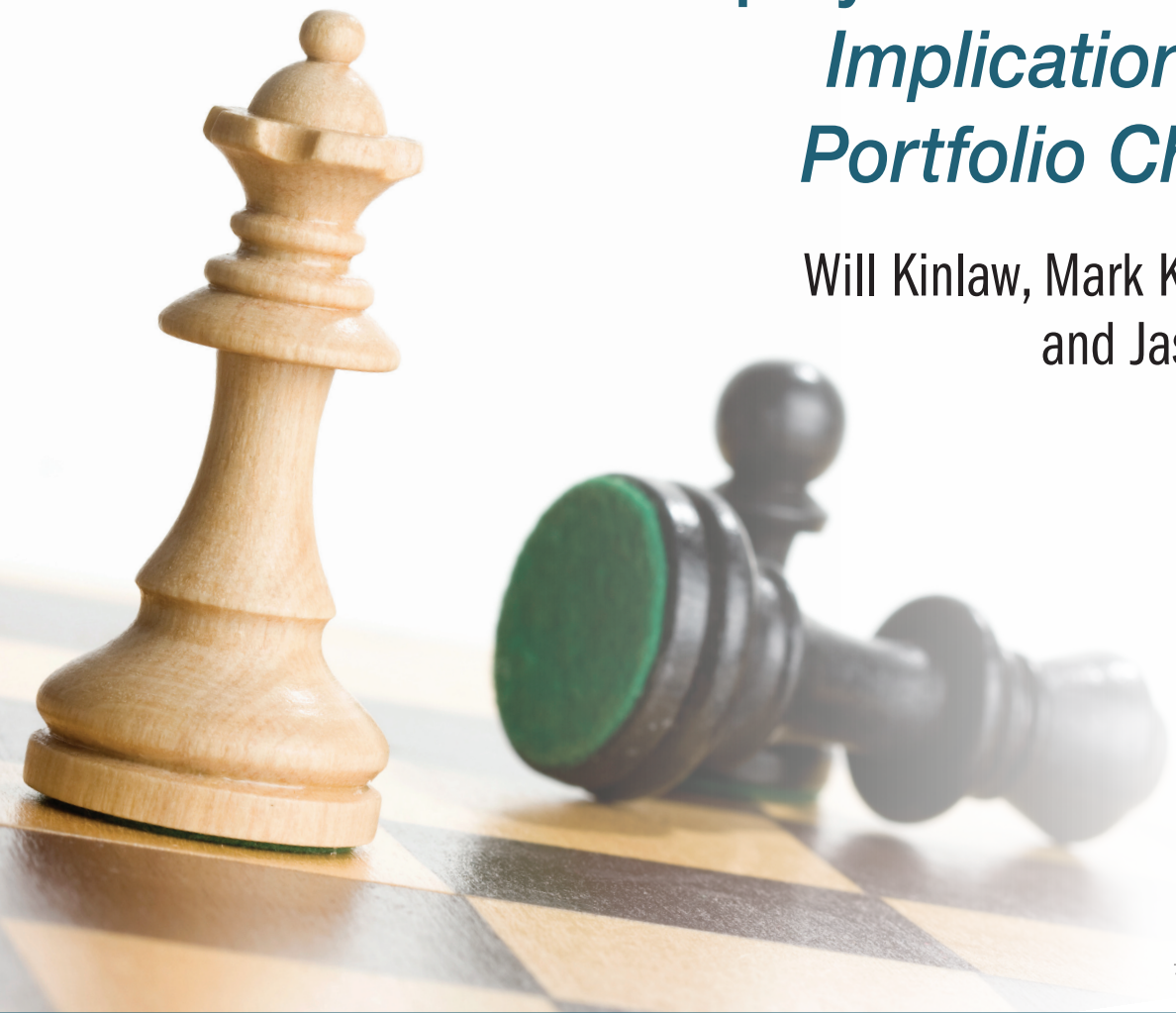

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Many institutional investors allocate significant funds to private equity despite the illiquidity of this asset class and the relatively high fees charged by private equity managers. We suspect that investors are attracted to private equity for several reasons:

1. Some investors believe they can identify superior private equity funds whose performance will more than offset their illiquidity and high fees.
2. Other investors, who may not be skilled at identifying superior funds, expect private equity as an asset class to outperform public equity by a margin sufficient to offset its illiquidity and high fees.
3. Still others, not constrained by liquidity, seek to capture a premium for bearing illiquidity.

We use a proprietary database of private equity returns to measure the excess return of private equity over public equity and to partition this return into two components: an asset class alpha[1] and compensation for illiquidity. Our results show that 75% of the excess return of private equity comes from an asset class alpha.[2] Moreover, we demonstrate that investors can obtain the asset class alpha of private equity in the public equity market. This means that investors who are not skilled at identifying superior private equity funds should invest in this asset class only to extract an illiquidity premium.

We organize this article as follows: In the first part, we provide a brief review of related literature. In the next section, we describe the State Street Private Equity Index (SSPEI), which serves as the basis of our analysis, and we compare the SSPEI to other private equity indexes. We then present evidence that private equity delivers an excess return net of fees relative to public equity and adjust the risk of private equity to offset the biases introduced by performance fees and valuation smoothing. Then we partition the excess return of private equity into an asset class alpha and an illiquidity premium. In the fourth section, we show how to determine the optimal allocation to private equity in light of the decomposition of its excess return. Finally, we summarize the article in the last section.

RELATED LITERATURE

Researchers have studied private equity from several perspectives that are related to our research, including factor exposures, premium relative to public equity, and the investment cycle of private equity.

Franzoni, Nowak, and Phalippou [2012] fitted a four-factor model to private equity

returns. They found significant exposure to liquidity, market, and value factors, but not to a size factor. They also found that, with four factors, alpha is zero and the liquidity risk premium is about 3% annually. They measured the liquidity factor as the return of a long–short portfolio of stocks sorted according to their sensitivity to changes in market liquidity. They did not consider sectors. Pederson, Page, and He [2014] employed a lagged factor model to describe the performance of a variety of alternative asset classes and found that private equity has exposure to beta, size, value, and liquidity factors; they also did not consider sectors.

Ang et al. [2014] created a time series of private equity values to a limited partner (LP) investor and decomposed the related returns into passively replicable returns and a private equity alpha or premium. They did not consider sector weights in determining passively replicable returns.

Kaplan and Schoar [2005] evaluated the performance of private equity funds and found that their average performance net of fees was approximately equal to the return of the S&P 500 Index. However, they also found substantial variation in performance across private equity funds. Harris, Jenkinson, and Kaplan [2013] studied performance across types of private equity funds and noted that buyout funds outperformed public equity by about 3% per year, whereas venture funds outperformed public equity during the 1990s but underperformed during the 2000s.

Lerner and Schoar [2005] examined the investment cycle of private equity managers. They found that funds invested in industries with longer investment cycles impose more transfer constraints on their investors. Therefore, managers of these funds screen for investors who are less sensitive to liquidity shocks. Barrot [2012] investigated whether the contractual horizon of private equity funds influences a manager's willingness to invest in innovative companies; he determined that private equity managers are more inclined to seek out innovative targets if the contractual horizon is longer. Barrot measured innovation as the rate of growth in a company's patent stock.

Our contribution in this article is related to these three streams of literature. We estimate private equity exposure, but we do so using economic sectors rather than factors. Of particular note, we offer evidence that private equity sector exposures are predictive of public equity performance. We document the excess return of private equity relative to public equity, and we refine this analysis by partitioning excess return into an asset class alpha and an illiquidity premium. We also address the life cycle of private equity in our analysis of the illiquidity premium. In fact, Barrot's [2012] result supports our conjecture that lock-ups enable private equity managers to extract a premium by investing in more innovative, and hence riskier, ventures. Finally, we evaluate how private equity performance affects portfolio choice from a normative perspective.

STATE STREET PRIVATE EQUITY INDEX

In 2005, State Street Corporation constructed the SSPEI, a private equity index updated quarterly, to evaluate the performance of actively managed private equity portfolios. As of June 30, 2014, the SSPEI is derived from the data of 2,411 global private equity partnerships, with funds distributed across various investment styles, vintage years, and geographic regions. It represents approximately $2.3 trillion of total capital commitments, which constitutes slightly more than half of the private equity market.

State Street's clients are large institutional investors, such as public and private pension funds, endowment funds, foundations, sovereign wealth funds, and family offices, which invest as LPs in private equity funds. The SSPEI is based on the cash flows of these LPs, which State Street captures and records in its role as custodian and reconciles with notifications from general partners (GPs). To approximate the full funds' cash flows, the individual LPs' shares are grossed up to the total partnership level based on the LP's commitment percentage for each particular fund; the resulting cash flows are then aggregated to produce index results. State Street computes a variety of performance metrics from the SSPEI, including an internal rate of return (IRR), which complies with Global Investment Performance Standards (GIPS) standards and is the basis of our analysis. The IRR calculation is based on daily cash-on-cash returns, modified for the residual value of the partnership's equity. The pooled return is the sum of all cash flows and net asset values. This cash flow series is then used to create an investment-weighted return; all returns are net of fees, expenses, and carried interest. The SSPEI is updated every quarter, approximately 100

EXHIBIT 1
Comparison of Private Equity Indexes

		State Street	Thompson Venture Economics	Cambridge Associates
Data	Source	LP transactions and valuations provided to custodian	Voluntary, self-reporting by GPs	Combination of voluntary, self-reporting by GPs and data provided by LP consulting clients
	Coverage	2,411 unique private equity partnerships representing $2.3 trillion in capital commitments from vintage years 1980 to present	2,043 unique private equity partnerships representing $1.34 trillion in capital commitments from vintage years 1969 to present	2,521 unique private equity partnerships from vintage years 1981 to present
	Timing	Transaction data collected daily; index published quarterly with a 105-day lag (120 days for Q4)	Survey data collected quarterly; index published quarterly with a 110-day lag (130 days for Q4)	Transaction and survey data collected quarterly; index published quarterly with a 110-day lag (130 days for Q4)
Methodology	Calculation	Internal rate of return; cash flows are aggregated daily	Internal rate of return; cash flows are aggregated monthly	Internal rate of return; cash flows are aggregated quarterly (reflected on the 45th day of the quarter)

Notes: Coverage statistics are as of the most recent available date: June 30, 2014, for State Street and as of January 2014 for Cambridge and Thompson. State Street and Cambridge Associates provide early estimates of quarterly performance approximately 90 days after quarter end. Information regarding Cambridge and Thompson is sourced from their websites.

days after quarter end, but year-end results may not be available until 120 days after quarter end as a result of delays associated with annual audits.

The SSPEI has several important advantages. First, it does not rely on voluntary self-reporting by GPs and therefore does not suffer from any associated biases. Second, as custodian, State Street has an accurate account of the amounts and timing of all cash flows related to each LP's investments, and as such, its historical returns are never restated; they reflect the actual experience of LP investors and are not subject to backfill or survivor bias. Finally, State Street is an independent, third-party service provider that has no conflicts of interest because it does not act as an investment advisor or placement agent for the funds. Exhibit 1 provides a comparison of the major private equity indexes. Exhibit 2 shows the types of funds included in State Street's database, as well as the regional distribution and the IRR associated with these categories, and Exhibit 3 provides a detailed description of the cash flows used to generate the IRRs.

EXHIBIT 2
Fund Type, Region, and Internal Rate of Return (as of June 30, 2014)

		Number of Funds	Commitment ($ billions)	Internal Rate of Return
Coverage by Fund Type	Buyout	1,128	1,624	13.4%
	Venture Capital	940	318	14.0%
	Private Debt	343	326	11.6%
	Total	**2,411**	**2,267**	**13.3%**
Coverage by Region	U.S.	1,851	1,602	13.6%
	Europe	284	477	13.6%
	Rest of World	276	187	8.2%
	Total	**2,411**	**2,267**	**13.3%**

Note: Internal rate of return is since inception.

EXHIBIT 3
Private Equity Cash Flows Included in Internal Rate of Return Calculation

Direction of Cash Flow	Type of Cash Flow	Description
Contribution	Capital Call	Capital call for investment or working capital
	Management Fee Inside	Capital call for periodic management fees inside of commitment, net of any waivers or offsets
	Management Fee Outside	Capital call for management fees outside of commitment
	Subsequent Close Interest Expense	Interest or other fee paid by the LP to other LPs for joining the partnership late or in a subsequent round closing
	Partnership Expenses Inside of Commitment	Capital call for all partnership expenses, organizational costs, legal expenses, and other expenses that are inside of commitment
	Other Expenses Outside	Capital call for all other expenses or organizational costs that are outside of commitment
	Temporary Return of Capital	Represents a distribution to LPs from GP due to previously called capital, which goes unused. Recallable for future investments.
	Deemed GP Contribution	Call from LPs, on behalf of GP's share of a capital call (typically serves as an offset to future management fees)
Distribution	Return of Capital – Cash	Return on invested capital from the full or partial sale of an underlying holding
	Realized Gain (Loss) – Cash	Realized gain (or loss) on the sale of an investment
	Return of Capital – Stock	Cost basis of stock distribution
	Realized Gain (Loss) – Stock	Realized gain (or loss) from stock distribution
	Recallable Distribution	Distribution (return of capital, gain or otherwise) that is subject to recall for future investment
	Clawback	Return of excess carry distributed to GP, as defined by the waterfall calculation in the LPA
	Dividends	Dividend income earned from underlying holdings
	Interest Income	Interest income earned from underlying holdings

LPA = limited partnership agreement.

EXCESS RETURN OF PRIVATE EQUITY AND ITS COMPONENTS

We used the SSPEI to measure the excess return of private equity and to partition the return into two components: an asset class alpha and a premium for illiquidity. We assume that any manager-specific alpha beyond the asset class alpha nets to zero across our universe of more than 2,000 partnerships. We conjecture that private equity managers collectively produce an asset class alpha because they anticipate the relative performance of economic sectors and offer two explanations for this outperformance. First, many private equity funds, such as venture capital funds, focus on emerging segments of the economy in which innovation is likely to be concentrated; private equity managers are the first

investors to be exposed to these innovations because entrepreneurs seek early funding. As these innovations take hold, many of the companies responsible for them go public and attract additional funding. Moreover, existing public companies in the same sectors may benefit from innovation by extension because investors observe successful ventures and channel even more funds into these segments of the economy. These private equity funds, therefore, have first mover advantage.[3] Other private equity funds, such as buyout funds, focus on underperforming segments of the economy. Companies in underperforming segments may be oversold and are thus likely to outperform in the future. It may, therefore, be the case that private equity managers anticipate outperformance, whereas public investors respond to outperformance.[4]

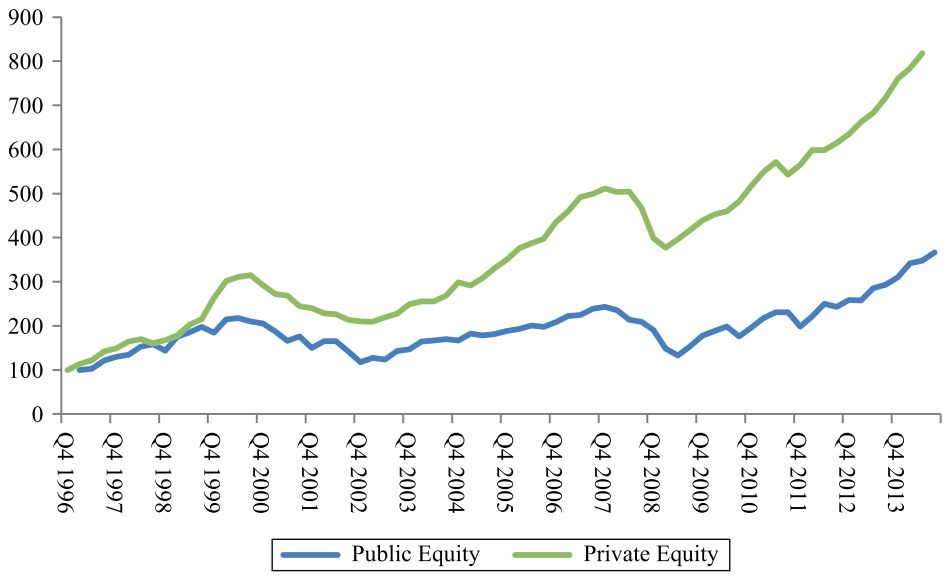
We model the illiquidity premium offered by private equity as the residual of asset class alpha. Although we do not estimate the illiquidity premium directly, we suspect it exists for two reasons: Privately held firms are less encumbered by disclosure requirements, which might otherwise discourage them from accepting beneficial short-term risks; and private equity funds have lock-up provisions, which insulate them from potential withdrawals should they experience transitory losses while pursuing greater long-term gains. These features grant private equity managers more flexibility to exploit long-term investment opportunities.[5]

Our explanation of private equity alpha and the illiquidity premium does not exclude the possible influence of other accounts; we offer only conjecture rather than concrete evidence[6] and are open to alternative views. Nonetheless, our focus is not to rationalize private equity alpha and the illiquidity premium, but rather to document and measure them. We base our analysis on a subset of the SSPEI that includes only U.S. funds.[7] Henceforth, our use of the acronym SSPEI refers to the U.S. subset of that index.

Exhibit 4 shows the cumulative return of private equity (the SSPEI) alongside the cumulative return of public equity (the capitalization-weighted MSCI USA Index) and reveals that U.S. private equity as an asset class produced a higher return than U.S. public equity over the 18-year period for which we have data (12.76% versus 7.70%, respectively). Based on observed standard deviations, the U.S. private equity class yielded

EXHIBIT 4

Cumulative Return of U.S. Private and Public Equity, December 31, 1996–June 30, 2014



Notes: The chart shows hypothetical value of $100 invested in private equity (SSPEI) and public equity (MSCI USA) on December 31, 1996. MSCI USA returns are quarterly total returns gross of taxes. The SSPEI includes venture capital, buyout, and distressed debt funds within the U.S. Its returns, which are net of fees, are dollar-weighted (IRR) within quarters, and time-weighted across quarters.

this return at significantly less risk than public equity (12.28% versus 18.05%, respectively).

However, the observed standard deviation understates private equity's true risk for two reasons. First, performance fees reduce upside returns but not downside returns; thus, standard deviations calculated net of fees understate risk. We must correct for this bias by reverse-engineering the fee calculation to derive a volatility measure that correctly captures downside deviations. Second, fair-value pricing also dampens observed volatility because these prices are anchored to prior-period prices. Therefore, we must de-smooth private equity returns to eliminate this bias. Exhibit 5 shows the observed volatility of public equity (MSCI USA) and private equity (SSPEI), as well as the implicit volatility of private equity after correcting for the biases arising from performance fees and valuation smoothing.

It appears, based on the data in Exhibit 5, that private equity is an attractive alternative to public equity even after accounting for a more realistic assessment of its risk. At this point, we might conclude that investors would be correct to choose private equity over public equity if they can match the performance of the average private equity manager and if the excess return adequately compensates them for the illiquidity of private equity. However, such a conclusion could be misguided because, as we suggested earlier, part of the excess return might constitute an asset class alpha arising from the ability of private equity managers to anticipate the relative performance of public equity sectors. If this is the case, we should expect a public equity index whose sector weights reflect the exposures of private equity investors to outperform a capitalization-weighted public equity index. We refer to this sector-mimicking index as liquid private equity.

We estimate private equity sector exposures by regressing quarterly SSPEI returns, net of market returns, on quarterly MSCI USA sector returns, net of market returns, using a step-wise regression.[8] We used rolling five-year windows and estimated a cumulative beta for each sector by summing all significant coefficients across lags, including negative coefficients. This calibration implies that, on balance, we capture sector exposures with a mean lag of 2.5 years.

We created a liquid private equity index as follows: We standardized each coefficient by subtracting from it the mean coefficient, and then dividing this difference by the cross-sectional standard deviation of the coefficients. We scaled these standardized coefficients to produce expected returns by multiplying them by a constant equal to 10%. We then performed a mean-variance optimization to derive portfolio weights, shown in Exhibit 6, which indicates significant variation in weights through time. This variation suggests that the index's performance is not determined by just a few sectors.[9]

We note that the time period for this analysis, which begins in 2002, excludes the dot-com boom and bust of the late 1990s. These periods are excluded because we require a five-year historical window to estimate out-of-sample betas for the backtest. Were we to include this period, our results might change; an interesting extension of this research would be to compare these regression-based sector exposures with the reported sectors associated with actual private equity deal activity. Unfortunately, we do not have access to such vendor data at this time.

Next, we computed the cumulative return of this liquid private equity index (Exhibit 7), assuming quarterly rebalancing, and compared it with the cumulative return of the capitalization-weighted MSCI USA. The liquid private equity index produced an annualized cumulative return of 9.26% compared with 6.69% for the MSCI USA, for an annualized excess return of 2.57%.[10]

The predictive power of private equity sector exposures is evident from the differences in subsequent public

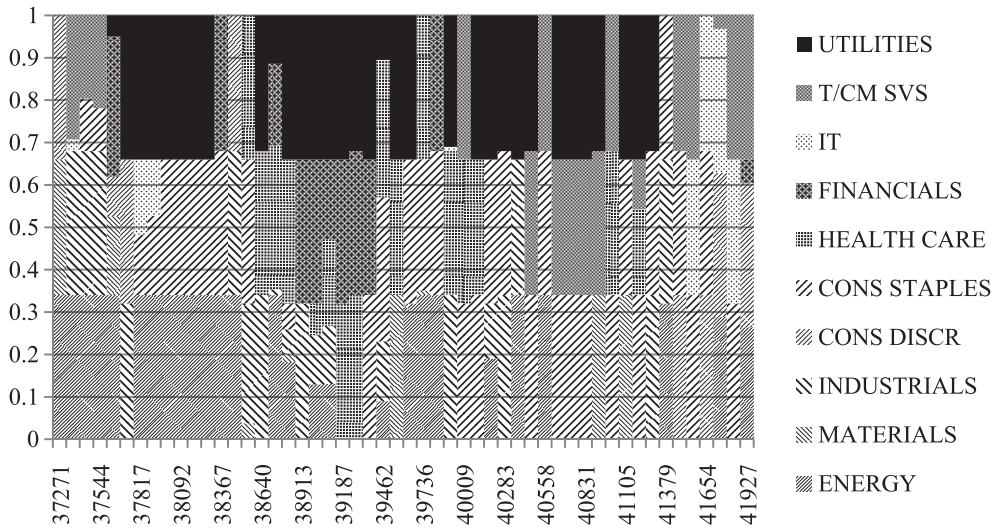
EXHIBIT 5
Adjustment for Performance Fees and Valuation Smoothing, December 31, 1996–June 30, 2014

	MSCI USA	SSPEI	SSPEI Adjusted for Fees	SSPEI Adjusted for Fees and Smoothing
Annualized return	7.70%	12.76%	12.76%	12.76%
Annualized standard deviation	18.05%	12.28%	13.18%	22.20%
Return-to-risk ratio	0.43	1.04	0.97	0.57

Notes: To adjust for fees, we converted net-of-fee returns to gross-of-fee returns by restoring a base fee (2% annualized) and a performance fee (20% in excess of a 7.5% hurdle rate) using the model of Kinlaw, Kritzman, and Turkington [2013]. A simulation approach that accounts for fee accruals and multiple funds produces similar results. We de-smoothed returns using the simple first-order autoregressive model of Kinlaw, Kritzman, and Turkington [2013]. More sophisticated algorithms that optimize the number of lags produce similar results. See, for example, Neumaier and Schneider [2001].

EXHIBIT 6

Liquid Private Equity Sector Weights, January 15, 2002–October 14, 2014



Notes: To estimate sector exposures, we regressed quarterly excess returns of the SSPEI (relative to MSCI USA) against quarterly excess returns of 10 MSCI USA sector indexes (relative to MSCI USA) using a step-wise regression model. We netted out market returns to reduce multicollinearity and improve the reliability of our results, given the arbitrariness of step-wise sequencing. We included contemporaneous returns plus three lags in our regression; for each lag, we used a rolling five-year window. Independent variables (sector-lag) were required to have an initial P-value of 10% or less to be included in our model. We converted sector exposures (betas) into weights each quarter as follows. First, using the methodology described, we standardized each sector's coefficient and converted it into an expected return. We then performed a mean-variance optimization to derive portfolio weights and estimated the covariance matrix from the rolling five-year sample of trailing quarterly sector returns. We used a risk aversion parameter of 0.5 in the mean-variance optimization and imposed an upper bound on each sector weight equal to one-third of the portfolio (34%). Removing this upper bound improves the performance of liquid private equity but results in concentrated positions.

equity sector excess returns, depending on whether their regression coefficients were significantly negative, insignificant, or significantly positive (Exhibit 8). The excess returns do not sum to zero because we did not account for sector weights in this analysis. The weighted-average excess return in a given quarter is 0%.

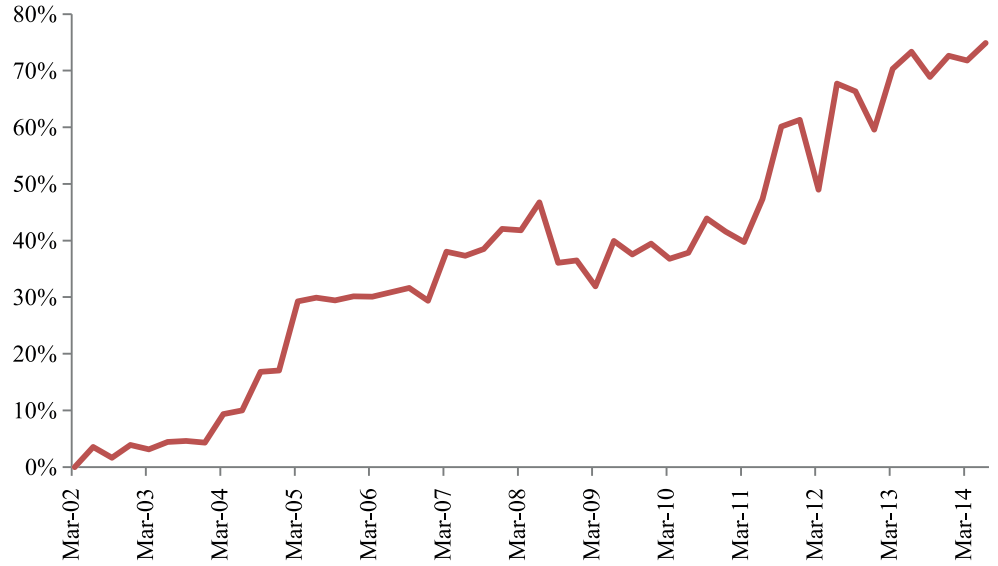
Next, we examine the decay rate of the private equity sector information by postponing rebalancing for intervals ranging from one to four years and found that private equity sector exposures were informative for several years beyond the mean estimation lag of 2.5 years (Exhibit 9). These results support our conjecture that the implicit, and perhaps unintended, sector choices of private equity managers predict the subsequent performance of public equity sectors with a substantial lead time, which is consistent with the notion of a J-curve investment cycle.

Exhibit 10 shows the relationship between the excess returns of liquid private equity and private equity relative to public equity. These annual excess returns, which are beta-adjusted, show that liquid private equity tends to outperform public equity during the same years when private equity outperforms public equity. The correlation between the two series is 53%.

Our next task is to differentiate the asset class alpha from an illiquidity premium. We first scale the returns of public equity and liquid private equity so that they are risk equivalent to the return of private equity. We carry out this transformation by multiplying the public equity and liquid private equity returns by the ratio of private equity volatility to the respective volatilities of public equity and liquid private equity.[11] We then subtract the risk-equivalent return of public equity from the risk-equivalent return of our liquid private equity index to estimate the asset class alpha, and we subtract alpha from the excess return of private equity to estimate the illiquidity premium.

EXHIBIT 7

Cumulative Excess Return of Liquid Private Equity Index, March 31, 2002–June 30, 2014



Notes: We account for publication lags in this backtest. In practice, the SSPEI is available for each quarter with a lag of at most 100 days (as much as 120 days for Q4 returns). There are two parts to this lag: the first is the data collection lag, which is "hard" and lasts one quarter (90 days). The second is the index calculation lag, which we assumed to be 15 days but is shorter in practice. Hence, we rebalance our strategy on the 15th of January, April, July, and October based on SSPEI returns from the preceding Q3, Q4, Q1, and Q2, respectively. We include round-trip transaction costs of 30 basis points, given that this strategy could be implemented with sector exchange traded funds (ETFs). Turnover is approximately 160% per annum. These results are gross of investment management fees; however, their magnitude is sufficient to absorb reasonable fees.

EXHIBIT 8

Next-Quarter Sector Returns Conditioned on Coefficients, January 15, 2002–October 15, 2014

Significance of Coefficient	Next-Quarter Excess Return (Annualized)
Significant and negative	–0.59%
Not significant	0.70%
Significant and positive	4.85%

Notes: Results show average next-quarter excess return (relative to MSCI USA) for a sector when the sum of that sector's significant lagged coefficients is positive, zero (no significant coefficients), or negative. Results reflect all publication and calculation lags as described in Exhibit 7. With 95% confidence, we can reject the null hypothesis that the subsample of returns following positive coefficients has a mean that is lower than the mean of the subsample of returns following negative coefficients. This evidence supports our hypothesis that sector returns are higher following positive coefficients.

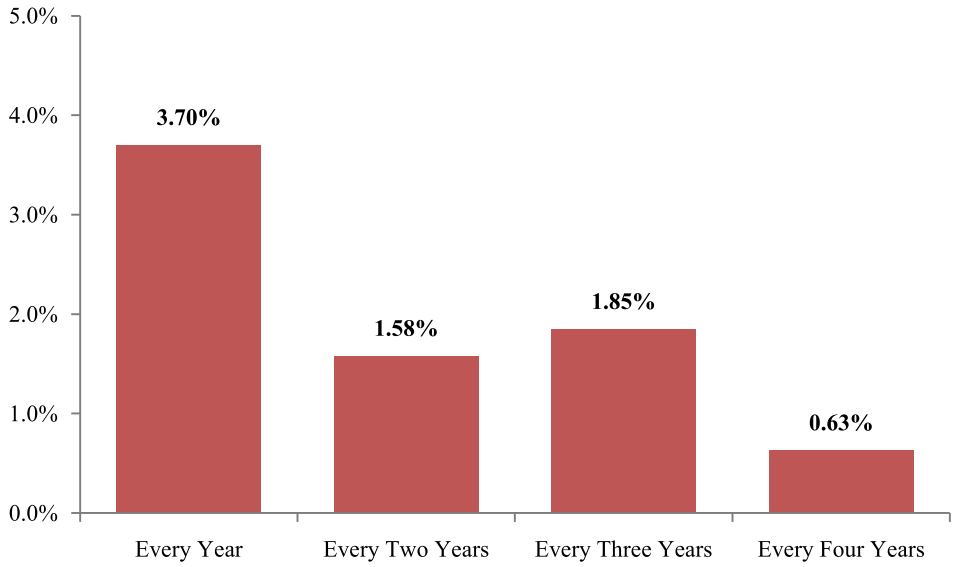
The risk-equivalent returns of public equity and liquid private equity are 6.46% and 9.85%, respectively; hence the asset class alpha equals 3.38% (9.85% – 6.46%). Because the total excess return of private equity is 4.50% (risk adjusted), the illiquidity premium is 1.11% (4.50% – 3.38%).[12]

We can replicate these results based on a subset of the private equity universe associated with a specific investment style. The asset class alpha derived from the SSPEI comprised of U.S. venture capital investments is 0.94%; for the SSPEI comprised of U.S. buyout investments, it is 3.68%. This discrepancy suggests that the sector information associated with buyout investments contained more information over this time period and is consistent with the higher returns of buyout funds compared with venture funds during our sample period (13.63% and 9.22% annualized, respectively). As we would expect, the two sectors exhibit different sector exposures as well: Relative to venture capital, buyout had higher average exposure to the energy and financial sectors and lower exposure to the IT and telecommunications sectors.

It may be tempting to argue that the illiquidity premium we distilled from the greater return of private equity as compared with large-capitalization

EXHIBIT 9

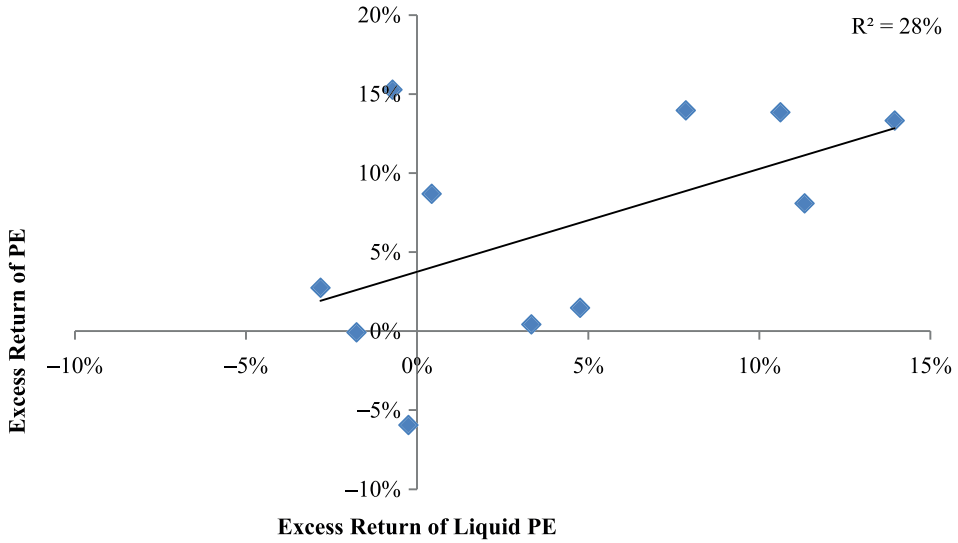
Liquid Private Equity Excess Return with Delayed Rebalancing



Notes: The chart shows how the annualized excess return of liquid private equity (relative to MSCI USA) changes when it is rebalanced less frequently. Results, which are rebalanced quarterly, cover the same time period as that in Exhibit 7. Results are net of transaction costs (see Exhibit 7 for details).

EXHIBIT 10

Excess Returns of Liquid Private Equity and Illiquid Private Equity, 2003–2013



Notes: The chart plots beta-adjusted excess returns of liquid private equity against beta-adjusted excess returns of private equity (SSPEI). To beta adjust returns, we estimate the beta of both private equity (SSPEI) and liquid private equity relative to public equity (MSCI USA) based on annual returns. We then subtract the quantity beta multiplied by public equity return from each annual observation. We use annual returns (calendar years) to reduce the impact of smoothing in the private equity returns. Results cover the period from 2003 (the first complete calendar year in our backtest) through 2013 (the last complete calendar year).

EXHIBIT 11

Disentangling the Private Equity Excess Return, March 31, 2002–June 30, 2014

	Public Equity	Liquid Private Equity	Private Equity
Return	6.69%	9.26%	10.96%
Risk	17.46%	15.44%	16.64%
Return-to-risk ratio	0.38	0.60	0.66
Return rescaled to PE risk level	6.46%	9.85%	10.96%
Premium vs. public equity	0.00%	3.38%	4.50%
Private equity asset class alpha			3.38%
Private equity illiquidity premium			1.11%
Total PE premium			4.50%

Notes: Liquid private equity is net of transaction costs (see Exhibit 7 for details). To compute the asset class alpha, we first rescale the returns of public equity and liquid private equity such that they have the same risk level as private equity. Specifically, we de-lever public equity returns and lever liquid private equity returns assuming an interest rate/borrowing cost of 1.8%, which is the annualized return of the JP Morgan 1-Month Cash Index over the backtest period.

public equity (as shown in Exhibit 11) partly reflects a small-capitalization premium. This may be the case, but because small companies are relatively expensive to trade and therefore partly illiquid, we choose to interpret the premium of small companies as a component of the illiquidity premium. We prefer to estimate the illiquidity premium of private equity based on a highly liquid index rather than an index that itself is partly illiquid.[13] Furthermore, the excess returns of liquid private equity relative to public equity do not reflect exposure to a size factor. Exhibit 12 shows the factor exposures of liquid private equity as well as their *t*-statistics.

This decomposition of the private equity excess return into an asset class alpha and an illiquidity premium has significant implications for optimal allocation to private equity, which we explore next. We base the remainder of our analysis on results using the MSCI USA as benchmark for the reasons we have just cited.

EXHIBIT 12

Factor Exposures of Liquid PE's Excess Returns, March 31, 2002–June 30, 2014

Factor	Coefficient	*t*-Stat
Market beta	–0.20	–2.77
Small cap	–0.17	–1.07
Value	–0.02	–0.16
Momentum	–0.02	–0.33
Adjusted r-squared	18.89%	
Regression alpha	4.14%	1.92

Notes: We regress quarterly excess returns of liquid private equity (relative to MSCI USA) against factor returns from Ken French's website. Regression alpha is annualized but its t-statistic is based on quarterly data. The P-value for the regression alpha is 6%.

OPTIMAL ALLOCATION TO PRIVATE EQUITY

In this section, we determine the optimal allocation to private equity in light of our decomposition of its excess return into an asset class alpha and an illiquidity premium. We assume that the investor has the option to allocate to four asset classes: fixed income, public equity, liquid private equity, and private equity.[14] Our intent is to show how the optimal allocation to private equity shifts as we introduce liquidity and liquid private equity into the portfolio construction process.

We carry out our analysis by applying a variant of mean-variance analysis that was introduced by Kinlaw, Kritzman, and Turkington [2013]. Their framework treats liquidity as a shadow allocation dependent on

EXHIBIT 13

Liquidity Benefits and Illiquidity Penalties

	Return (bps)	Risk (bps)	Attached to:
Benefits			
Market timing	40	80	Liquid assets
Total shadow asset	**40**	**80**	**Liquid assets**
Penalties			
Sub-optimality cost from asset drift	46	0	Illiquid assets
Sub-optimality cost from capital calls	3	0	Illiquid assets
Borrowing cost from capital calls	20	16	Illiquid assets
Total shadow liability	**69**	**16**	**Illiquid assets**

Notes: These estimates are illustrative and can be found in Kinlaw, Kritzman, and Turkington [2013]. They are derived by simulating the expected return and risk of several activities in which liquidity enables the activity or illiquidity prevents the investor from engaging in the activity. Tactical asset allocation is an example of using liquidity to raise expected utility. The investor would model the expected return and risk of tactical asset allocation and overlay these values on the tradable assets. Rebalancing a portfolio is an example of using liquidity to preserve a portfolio's expected utility. An investor would estimate the cost of not rebalancing and overlay this value on those assets within the portfolio that cannot be traded.

EXHIBIT 14

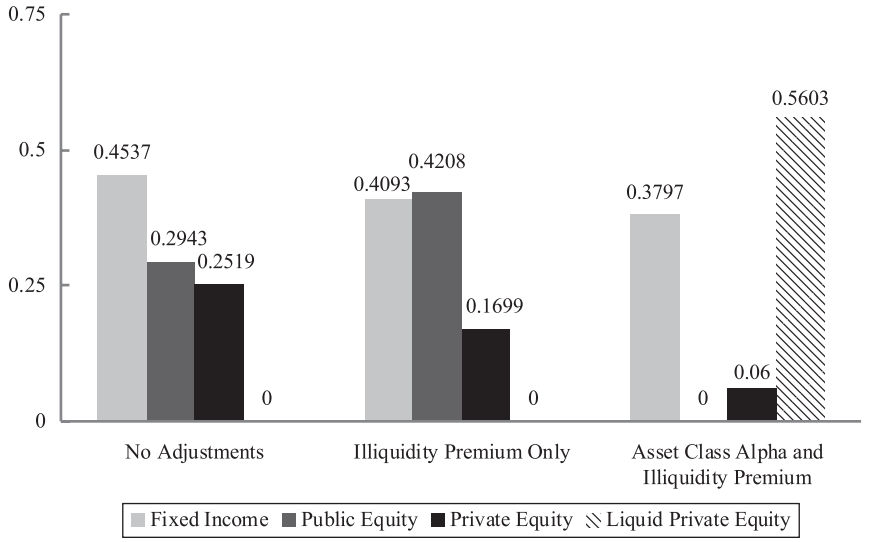
Expected Returns, Standard Deviations, and Correlations

Asset Class	Expected Return (%)	Standard Deviation (%)	Correlation					
			Public Equity	Fixed Income	Private Equity	Liquid Private Equity	Shadow Asset	Shadow Liability
Public Equity	8.50	15.00	1.00					
Fixed Income	4.00	8.00	0.00	1.00				
Private Equity	11.62	22.20	0.73	0.00	1.00			
Liquid Private Equity	10.72	15.44	0.89	0.00	0.59	1.00		
Shadow Asset	**0.40**	**0.80**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	
Shadow Liability	**–0.69**	**0.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**

Notes: We derive our capital market assumptions as follows. Public equity and fixed income expected returns are illustrative. The private equity expected return equals the public equity assumption plus the historical arithmetic premium of private equity relative to public equity (3.12%). The liquid private equity expected return equals the public equity assumption plus the historical arithmetic premium of liquid private equity relative to public equity (2.22%). Both premiums are from the period March 31, 2002 through June 30, 2014. The public equity and fixed income standard deviations are illustrative. The private equity standard deviation is the de-smoothed and fee-adjusted standard deviation of private equity from December 31, 1996 through June 30, 2014 (as shown in Exhibit 5). The liquid private equity standard deviation is the standard deviation of liquid private equity from March 31, 2002 through June 30, 2014 (as shown in Exhibit 11). The pair-wise correlations between public equity, liquid private equity, and private equity are from the period March 31, 2002 through June 30, 2014. All other correlations are illustrative and are assumed to be zero. All assumptions for the shadow asset and liability are from Kinlaw, Kritzman, and Turkington [2013], as shown in Exhibit 13.

EXHIBIT 15

Optimal Portfolio Weights Adjusted for Liquidity and Asset Class Alpha



Notes: This chart shows mean-variance optimal allocations based on the capital market assumptions shown in Exhibit 14. From each efficient frontier, we present the optimal portfolio with 10% standard deviation so that the three portfolios are comparable. The "No Adjustments" portfolio shows the optimal allocation absent the shadow liquidity asset and shadow liquidity liability. The "Illiquidity Premium Only" is the optimal allocation with the shadow asset and liability. The "Asset Class Alpha and Illiquidity Premium" portfolio is the optimal allocation when liquid private equity is added to the menu.

the manner in which it is deployed by investors. If an investor uses liquidity to raise a portfolio's utility beyond what would be expected if the portfolio's composition were held constant, then a shadow asset is attached to the assets within the portfolio that can be traded to capture this benefit. If instead liquidity is used to preserve the portfolio's expected utility, then a shadow liability is attached to those assets that are not tradable and thus

prevent the investor from preserving the portfolio's original expected utility. This approach for incorporating liquidity into portfolio choice has the virtue of converting liquidity into units of return and risk, as shown in Exhibit 13.

Next we combine our assumptions for the shadow asset and liability with our views for the explicit assets of the portfolio. We present these assumptions in Exhibit 14.

The decomposition of the private equity excess return into an asset class alpha and an illiquidity premium should have the following three consequences:

1. Decomposition should reduce investor attraction to private equity over liquid private equity because, although they both deliver the asset class alpha, liquid private equity delivers alpha without the encumbrance of illiquidity.
2. It should reduce the attractiveness of public equity relative to liquid private equity because, when the two have equal liquidity, liquid private equity offers an asset class alpha.
3. Decomposition should diminish the attraction to private equity relative to all liquid asset classes because it reveals a smaller illiquidity premium with which to offset the benefits of liquidity.

These expectations are confirmed in Exhibit 15, which shows how the optimal allocations to private equity and liquid private equity asset classes change as we first ignore liquidity and asset class alpha, then consider liquidity but treat the entire private equity excess return as an illiquidity premium, and finally recognize that private equity excess return comprises an asset class alpha as well as an illiquidity premium.

The specific allocations in our analysis depend on our assumptions for expected returns, standard deviations, and correlations. Nevertheless, we are very confident that the ordinal shifts observed in this analysis would prevail for any set of return and risk assumptions that are grounded in theory and informed by history.

SUMMARY

We used a proprietary database of private equity returns to measure the excess return of private equity relative to public equity covering a period of approximately 18 years. We then partitioned this excess return into two components: an asset class alpha and an illiquidity premium.

We supposed that private equity managers as a group generate alpha because entrepreneurs first seek to fund their innovations privately, and, as these innovations take hold, public investors follow. Hence, private equity managers have first-mover advantage. Alternatively or additionally, private equity managers may be skilled at identifying oversold assets that therefore have a relatively high expected return. We also conjecture that private equity managers earn an illiquidity premium because they are less burdened by disclosure requirements and because the lock-up periods they impose on their investors afford them greater flexibility to seek long-term investment opportunities.

Our empirical analysis offers persuasive evidence that the sector weights of private equity funds do indeed predict the subsequent performance of public equity sectors within both large- and small-cap universes. This means that investors can capture this asset class alpha using sector exchange traded funds (ETFs) to match the sector weights of private equity funds without incurring the encumbrance of illiquidity. We refer to this strategy as liquid private equity.

We then showed how this decomposition of the private equity excess return into an asset class alpha and an illiquidity premium affects the optimal composition of a portfolio. Private equity is less appealing than liquid private equity because liquid private equity delivers asset class alpha without subjecting the investor to illiquidity. Public equity becomes less attractive than liquid private equity because it does not offer an asset class alpha. Finally, private equity becomes less attractive than all liquid asset classes because it is seen to offer a smaller premium to compensate for its illiquidity.

The analysis presented in this article is intended as a proof of concept, which is why we have used simple procedures to estimate sector exposures and to construct the liquid private equity index. We expect that one could improve on our results, perhaps substantially, by employing more sophisticated tools.

ENDNOTES

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[1]Throughout this article, we use the word alpha to mean a model-free, volatility-adjusted return in excess of an illiquidity premium. We do not use a factor-based asset pricing model because these models assume that assets are easily tradable, which is not the case for private equity. Hence, private equity's return is more likely to be proportional to its total risk than its systematic risk.

[2]This specific attribution depends, in part, on the risk we assume investors are willing to accept in pursuit of alpha.

[3]Our conjecture does not necessarily imply that private equity managers are particularly clever. They may be the unwitting beneficiaries of smart innovators who seek private funding. In practice, we find that the sector exposures of buyout funds are more informative than the sector exposures of venture capital funds.

[4]This rationale may apply to industries and factors as well. We focus on sectors because it is easy to invest in them at low cost by using sector ETFs.

[5]One might argue that private equity managers generate incremental alpha by restructuring companies, including replacing management. We argue that this restructuring is enabled by lock-ups; hence, we characterize the incremental return from restructuring as part of the illiquidity premium.

[6]It is also possible that private equity funds invest in sectors that have recently become (or subsequently become) more risky, perhaps due to start-ups in the sector. To the extent that this is the case, the excess return of liquid private equity may be compensation for additional risk exposure. However, the modest realized volatility of the liquid private equity strategy relative to public equity suggests that this effect is, at best, a modest one.

[7]We focus on U.S. private equity funds because investors could capture the asset class alpha inexpensively in this market using sector ETFs. Furthermore, U.S. funds account for the preponderance of the private equity marketplace as well as 71% of our private equity database by capital commitments.

[8]We recognize the potential limitations of a step-wise regression. To reduce multicollinearity, we subtracted the market return from each sector's return to regress against the excess returns of each sector. The results presented in this article are intended as a proof of concept. In practice, we employ a proprietary algorithm that relies on a Lasso regression to control for the number of independent variables. These methodologies produce directionally similar results.

[9]Castellaneta [2014] offers additional evidence that the sources of private equity performance vary across sectors.

[10]As with any active investment strategy, the excess return of the liquid private equity strategy will erode as more investors pursue it. Given the depth of the large-cap U.S. equity market, we expect that the capacity for the liquid private equity strategy would be large. For example, as of June 2014, a suite of sector ETFs offered by one provider had an average daily volume of approximately $500 million and an average tracking error of approximately 1%. We would expect some of this tracking error to diversify away when multiple sectors are traded as a portfolio. At the cost of additional complexity, an investor could access even greater liquidity and lower tracking error by trading sector baskets of physical securities.

[11]We perform a Jarque-Bera (JB) test to determine whether these return series conform to a normal distribution. At the 99% confidence level, we cannot reject the null hypothesis that public equity and liquid private equity returns are normally distributed. We do reject the null hypothesis for private equity, which has an excess kurtosis of 2.94, compared to 0.40 and 1.00 for public equity and liquid private equity, respectively. All three series exhibit skewness that is modestly negative: –0.74 for public equity, –0.76 for liquid private equity, and –1.33 for private equity. If we perform the JB test on de-smoothed private equity returns, then we cannot reject the null hypothesis that private equity returns conform to a normal distribution. All estimates are based on quarterly returns from the period March 31, 2002 through June 30, 2014.

[12]We round these figures to the nearest basis point for presentation purposes, but we perform the arithmetic on unrounded figures. As such, the arithmetic appears to be off by 0.01%.

[13]This issue is largely one of semantics. We acknowledge that we can stratify what we call an illiquidity premium into a component due to the illiquidity of small companies and a component due to illiquidity arising from other features of private equity.

[14]We acknowledge that most sophisticated investors choose from a larger menu of asset classes, but we are confident that the essence of our analysis would prevail given any normal opportunity set. We therefore choose a framework that favors clarity over clutter.

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