Cash for Calls: A Quantitative Approach to Managing Liquidity for Capital Calls

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KEY FINDINGS

- Studies of private market investments tend to focus on the return premium associated with illiquid assets and their appeal relative to traditional public market assets. Far less attention is paid to the need for investors in these assets to earmark liquid funds for the capital calls endemic to private market investing—and, importantly, the resulting drag on total returns.
- Solving for the liquid allocation to complement a pending private market investment can be challenging. The speed and magnitude of realized calls are likely to be correlated—sometimes highly correlated—with financial market movements.
- We review historical private fund call behavior to evaluate the effectiveness of various liquidity solutions or cash management strategies. The average investor in private funds must manage uncalled capital for several years.
- "Liquidity tiering" has the potential to provide investors with additional returns relative to cash, with less risk than equivalent assets in public markets.

ABSTRACT

Investors in private assets typically must commit their funds to an asset manager. It is only after those funds are called at some unknown later date that investors receive exposure to the desired assets. We review data on calls and distributions for private equity and private debt funds over the past 30 years. We characterize the speed of calls and distributions for each asset, the impact the call speed (or lack thereof) has on investors' realized return on their committed capital, and the extent to which this call risk can be diversified across managers. Finally, we use the historical call data to illustrate "liquidity tiering," an asset allocation strategy that helps investors manage against their future commitments.

Investors in illiquid strategies typically cannot allocate all their capital immediately. Instead, these limited partners (LPs) usually have to commit to deploying their capital in multiple tranches over several years. In the interim, they face liquidity management challenges and the potential for an efficiency drag or "cash drag" on their committed but uncalled capital.

This article touches on several threads in the literature. While most research into private asset performance focuses on the investor's experience once funds are invested, such as Kaplan and Schoar (2005), Harris et al. (2014), and Braun et al. (2020), there are a few key exceptions. Phalippou (2008) highlights the distinction between a GP's IRR and an LP's realized return, and the mismatch in incentives where

a GP may prefer slower calls and more selective investments to boost IRR at the expense of an LP's realized performance. Ang, Papanikolaou, and Westerfield (2014) use the uncertain length of illiquidity to motivate the liquidity premium. The classic example of liquidity pressure for a portfolio, including private investments in Siegel (2008), excluded uncertain capital call timing. Still, when paired with Robinson and Sensoy's (2016) finding that net flows from private funds are procyclical—something we observe as well—it suggests that uncertain capital calls exacerbate this problem. Estimates of the effect of expected call speeds have substantial impacts on an LP's investment return in line with those in Meyer (2020).

Finally, like Arnold, Ling, and Naranjo (2017), we document substantial variation in call speeds around this average across managers in our sample. We find that some call risk can be diversified across managers, as in Phalippou and Westerfield (2014). However, when paired with the need to diversify across vintages, given the well-known macroeconomic determinants of performance (Arnold, Ling, Naranjo 2017), there are meaningful limits on what might be practical here, even for very large investors. We quantify these issues and augment this literature with a framework for managing liquidity to address future capital calls based on the historical call behavior of private equity and private debt funds.

Liquidity management includes several challenges. LPs must balance the risk and return of the uncalled capital against the uncertain timing of future calls. Conservative investments are more likely to meet committed calls but may significantly underperform the levels targeted for what is supposed to be a return-seeking allocation. On the other hand, risky investments may require the realization of losses to fund commitments and increase the risk of shortfalls versus committed capital. Navigating these trade-offs can be a challenge, but successfully doing so can simplify investments in, and potentially improve outcomes for, illiquid strategies.

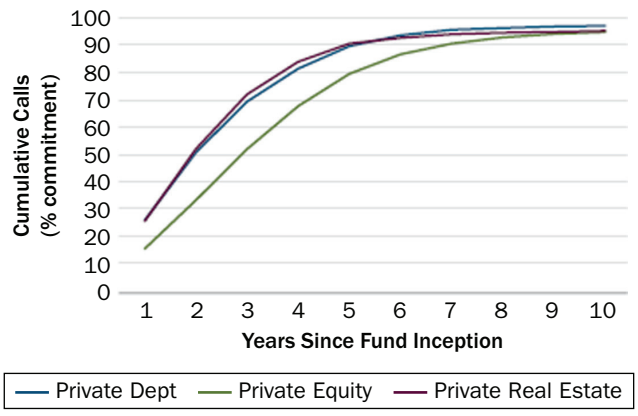
THE COST OF CASH

Perhaps the simplest and most conservative approach to managing uncalled capital commitments is a cash equivalent or money market investment. In other words, to allow their portfolios to harvest the outsized returns from illiquidity, investors often first allocate to the most liquid assets. In today's markets, however, the cost of such action can be high. Many central banks around the world have anchored their front-end rates near (or below) 0% for most of the past decade, and most market participants expect them to stay at or near these levels for some time (Fels and Balls 2021).

Investors who place their commitments in cash may find them languishing there for a surprising amount of time. Exhibit 1 shows the average call rates between 1992 and 2020 for private debt, private equity, and real estate assets. The average investors in private debt or real estate funds waited two years before half of their initial commitments were deployed, and saw 10% of their commitments uncalled after five years. The situation was even more concerning in private equity: Only about a third of the average investor's commitments were productively invested after two years, and one-fifth of the commitments remained uncalled after five years.

EXHIBIT 1

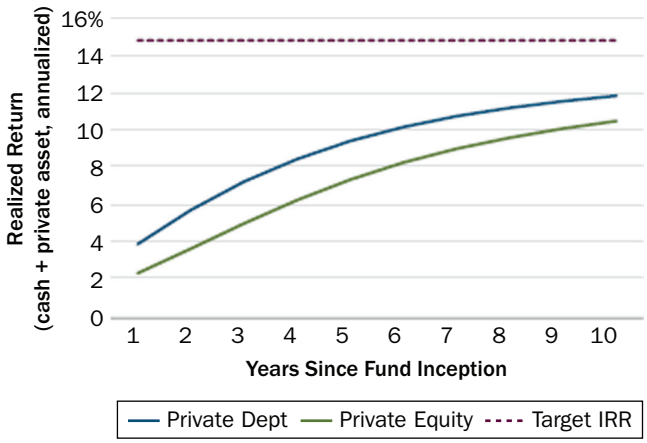
A Need for Speed? Call Rates for Private Investments



SOURCE: Author's calculations and Preqin. This exhibit shows the average call rate by tenure for all private equity, private debt, and private real estate funds in the Preqin database from 1992 to 2020 with at least five years of data. See Appendix 1 for more information on the data sample.

EXHIBIT 2

Quantifying Cash Drag



SOURCE: Author's calculations and Preqin. Assumes a 15% return on called capital in perpetuity and a 0% return on committed and uncalled capital. The call schedule is the average call rate by tenure for all private equity funds in the Preqin database from 1992 to 2020 with at least five years of data. See Appendix 1 for more information on the data sample. Hypothetical example for illustrative purposes only.

Needless to say, the cash drag from these call rates can be significant. We provide a simple calculation in Exhibit 2. If invested capital produced an internal rate of return (IRR) of 15% each year and committed capital was invested in cash yielding zero, after eight years, an investor in private debt or private real estate would receive annualized returns of 360 basis points (bps) lower than the IRR. Private equity has an even larger gap: After eight years, an investor's return on committed capital would be 525 bps per year lower than the 15% IRR of the investment, similar to the estimates in Meyer (2020).

One potential option to lessen the impact of cash drag would be to over-commit: pledge more for subsequent investments, targeting the desired investment that should line up with the average amount deployed in the long run. However, this involves substantial risk. Early in the life of a private investment, an investor faces a great deal of uncertainty about how much will be deployed. There is substantial dispersion in realized calls about this mean, even if investors construct a portfolio of managers in each vintage as shown in Exhibit 3.

Call risk does appear to be diversifiable, at least to some extent. An investor in private equity who randomly selected multiple managers in a given year experiences less volatility, though the risks remain substantial. As shown in the same exhibit, investors in private equity still would face a substantial amount of commitment risk even if they invested with many different managers.[1] For example, after three years, the average cumulative call rate is 66%. Still, intervals containing 95% of simulated cumulative calls after three years for an LP invested in 1, 5, and 10 randomly chosen managers are 77, 35, and 25 percentage points wide.

The exhibit aggregates the data averaged across all vintages. Much like the performance of the underlying vehicle, however, an investor's call experience and uncertainty vary with the original commitment date and the point in the economic cycle. While the overall average is 66% of their capital called after three years, as shown, investors would have seen between 57% and 73% of their capital invested.[2] However, the *uncertainty* around this average is relatively stable over time and does not appear related to the economic cycle.[3] An interesting implication of the stable uncertainty is that the increasing use of credit lines by private asset managers since the financial crisis does not appear to coincide with more predictable capital calls for their investors over time (we do see fewer, larger call events over time potentially as a consequence of increased credit usage as hypothesized in Ahlin and Granlund 2017).

In short, while call rates appear diversifiable, this risk would be challenging to diversify in practice. Given the minimum investment requirements for most funds in this space, the size of illiquid allocations, the number of vintages that would be

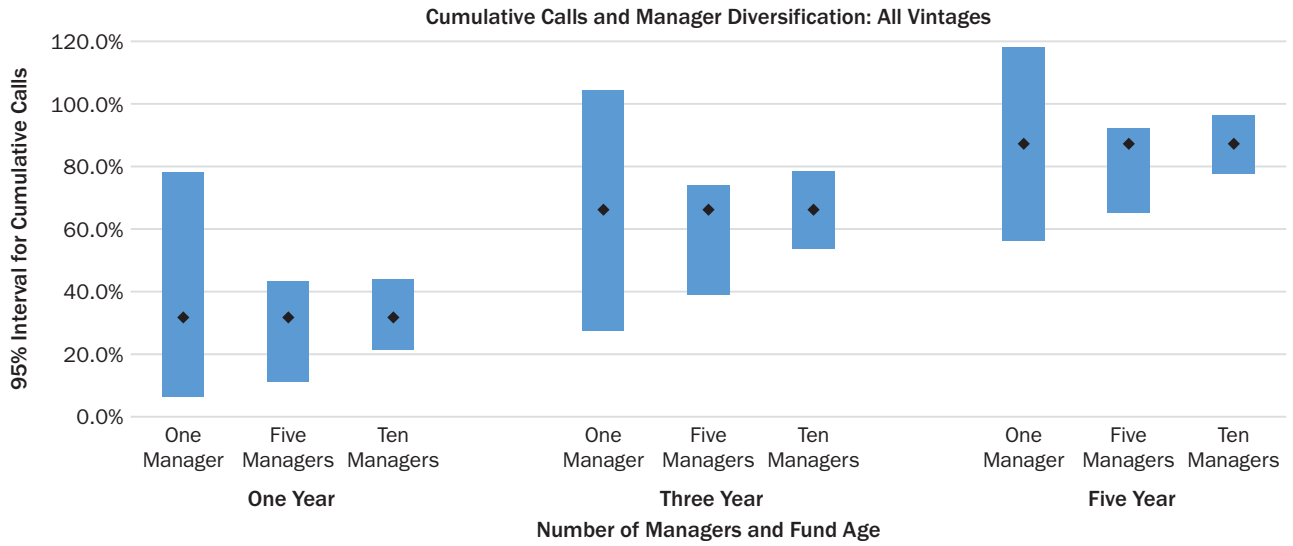
[1] Diversifying across managers in this way might become challenging quickly, as, given the macro dependencies in private asset returns (Arnold, Ling, and Naranjo 2017), prudent LPs would want to diversify their private investments across both managers and vintages to ensure they are not too exposed to an ill-timed market downturn.

[2] The low and high are in 2000 and 2005 respectively.

[3] For example, a portfolio of 10 random managers in 2000, 2007, and 2014 would see simulated 95 percent ranges about their means that were all between 22.3 and 23.1 percentage points wide. This range does not appear to vary with the economic cycle.

EXHIBIT 3

Manager Diversification



SOURCE: Author's calculations and Preqin. This exhibit contains the range of cumulative call experience for a private equity investment by years since the original commitment. The data reflect a date-weighted average of the call experience between 2000 and 2015. The 95% confidence interval is the difference between the 97.5th and 2.5th percentile of simulated cumulative calls with an equal amount of commitments made to each vintage's indicated number of managers. The call schedule used in the simulation is the average call rate by tenure for all private equity funds in the Preqin database with at least five years of data. See Appendix 1 for more information on the data sample. Hypothetical example for illustrative purposes only.

active in a strategic asset allocation, and the number of managers needed to diversify this risk in each vintage, many investors will not be able to diversify this risk away in practice. Even for those that do, there are substantial operational difficulties in perpetually selecting enough managers and vintages, and even those investors who could do so might find this a daunting prospect.

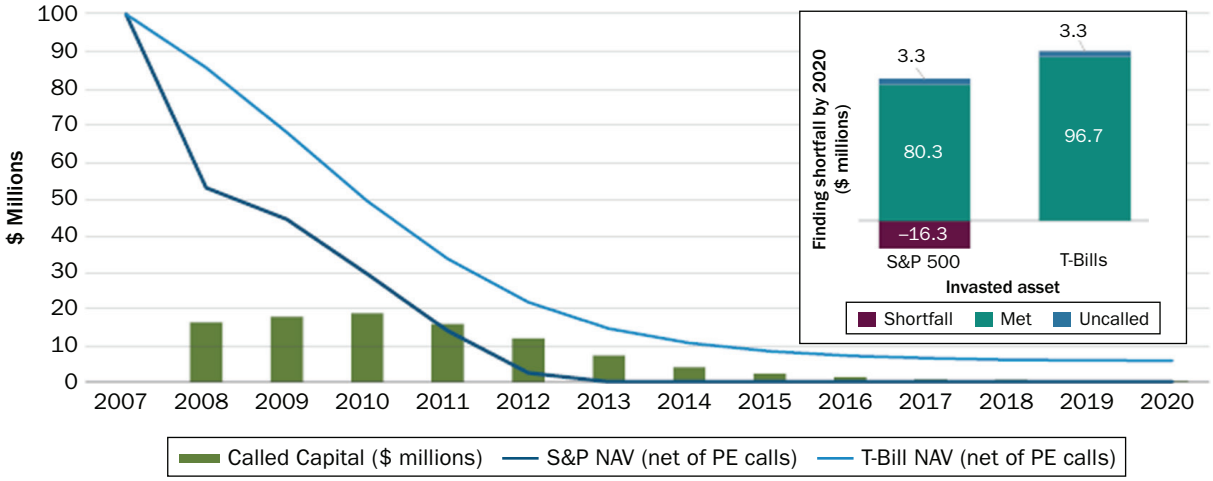
For these situations, a potential solution is to focus on vehicles designed to call and deploy capital more rapidly for their investors, such as evergreen funds. These options often quote lower return targets on invested capital. Still, their return on committed capital can be quite compelling compared with the effective return on commitments inclusive of call risk present in some vintage structures.

Finally, LPs could invest uncalled capital more aggressively, of course. Indeed, many investors seek to be fully invested as quickly as possible upon making an initial commitment. Their strategy is to replicate pending illiquid exposure as much as they can using public markets. The idea is that these funds are allocated to certain risks; therefore, they should be invested in public market equivalent (PME) assets with a risk/return profile as similar as possible to those risks while they await deployment into private investments. For example, uncalled private equity commitments may be invested in (potentially leveraged) public equities, while private credit commitments may be invested in high yield bonds.

In environments with positive returns, this approach tends to work well. All of these PME investments can provide daily liquidity through common investment vehicles, and, while their private counterparts may enjoy a liquidity premium over their public market equivalents (Baz, Stracke, and Sapra 2019a and 2019b), the return drag from this strategy can be materially less than that of cash equivalent investments as shown in Exhibit 2. However, as we saw in market drawdowns such as 2008 and March 2020, this approach comes with significant risks.

EXHIBIT 4

Sequence of Return Risk for Capital Calls



SOURCE: Author's calculations and Preqin. Assumes funds are invested in public equities (S&P 500 Index) or cash (ICE BofA Merrill Lynch 3-Month US Treasury Bill Index); the call schedule is the average call rate by tenure for all private equity funds in the Preqin database from 1992 to 2020 with at least five years of data. See Appendix 1 for more information on the data sample Hypothetical example for illustrative purposes only.

CALLS COMPOUND RISK

Portfolios that experience outflows, such as assets managed to fund future capital calls, are likely to behave very differently over time than portfolios that are not spent down. For such assets, it is no longer primarily the distribution of returns, but the sequence of returns, that determines performance. When a large drawdown occurs, its impact on the portfolio is amplified by any outflows. If the drawdown occurs early on, it can shrink the portfolio so much that the remaining assets are too small to materially take advantage of any subsequent price increases. This is most clearly seen with an example.

In Exhibit 4, we show the hypothetical portfolio performance of an investor who committed $100 million in capital to private equity in 2007. The committed assets are called and distributed in line with the real-world experience of investors in these funds during this period.[4] We compare the difference between investing committed but uncalled capital in three-month Treasury bills versus investing in the S&P 500. Needless to say, these assets had a very different total return experience over this time horizon; an investor in T-bills received an annualized return of 0.67% while an investor in US equities enjoyed average annual returns nearly 15 times higher (9.78%).

Despite this sizable difference in investment performance, the withdrawals to meet capital calls during this period would have had an irreversible impact on a portfolio invested in equities. Funds invested in equities would have been exhausted after Year 5 and thus unable to meet nearly 20% of the original commitment (to say nothing of enjoying the capital appreciation in the chosen asset). Simple T-bills fared much better, despite their lower returns. An investor in cash funding capital calls over

[4] The call schedule is the average call rate by tenure for all private equity funds in the Preqin database from 1992 to 2020 with at least five years of data. See Appendix 1 for more information on the data sample.

this period would have had no shortfall and still would have retained some wealth after meeting all capital calls—thus earning a higher combined return via the invested private equity funds.

The crystallization of losses of this sort is magnified for capital calls, as the outflows from the portfolio are not independent of financial markets. All else equal, forward-looking returns in public and private assets tend to become most attractive when prices fall. Thus, the best time to put money to work tends to be after a large market decline. Of course, the absolute worst time to sell a higher-risk replicating asset also tends to be after a large market decline—exactly when one would want to put committed capital to work.

Historical call and distribution data bear out this intuition. Over the full sample, call rates for private equity and private debt had a slightly positive relationship to public market returns (a 0.33 correlation for debt and 0.46 for equity). There is some evidence that call experiences—and the return potential—during downturns are meaningfully different than they are in more normal markets. When conditioning on stressed markets, Robinson and Sensoy (2016) find that funds that are more likely to call capital in down markets perform about 36% better over the life of the fund in absolute terms (0.35 higher undiscounted multiple) and about 15% better in terms of PME performance. Investors who could provide adequate liquidity during stress were able to harvest a significant return premium.

This nonlinear complexity and compound risk pose a challenge to public market equivalent strategies, though careful investors still have appealing options. Instead of a fully cash or fully PME approach, we favor a solution that leverages what we know about typical capital call behavior. Rather than a fixed allocation to a single asset, investments can be tiered such that the risk and investment horizon of each allocation are aligned with the pacing of commitments the allocation is intended to support. As we will see, this may allow investors to harvest a significant portion of the returns provided by PME-style investments and mitigate the risk that they will be unable to meet future capital calls due to untimely market drawdowns.

LIQUIDITY TIERING

In this section, we use the real-world call behavior of asset managers to show the impact of liquidity tiering for an investor in private assets—specifically, private debt.[5] Exhibit 5 displays an example of liquidity tiering in a simple three-strategy framework over a five-year period. Calls anticipated over the next year are held in active ultrashort investments with a duration under one year. The next tier consists of calls expected in the second and third years, held in slightly higher-risk (and higher-return potential) fixed income with a matching investment horizon.[6] Finally, all remaining calls are held in public market equivalent assets.

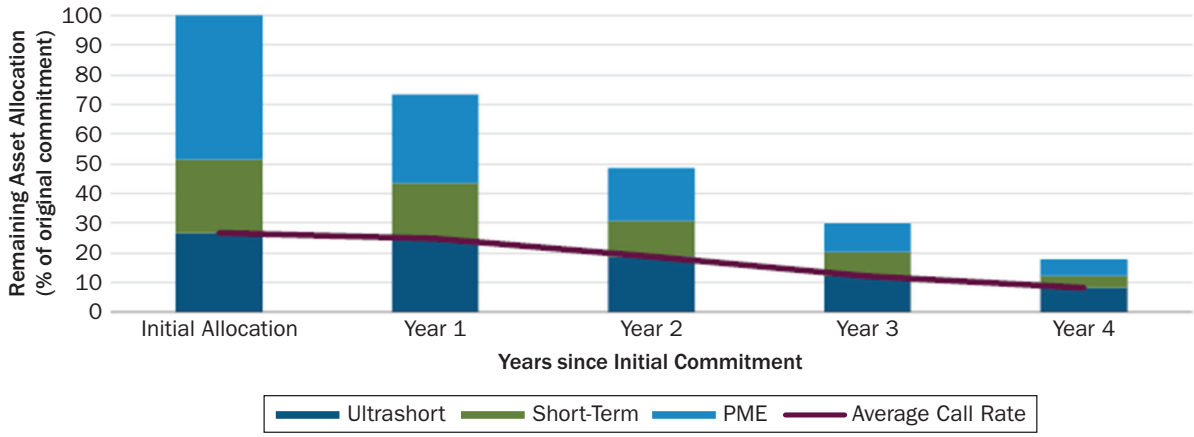
This strategy has several potential benefits. Investors with tiered liquidity tend to naturally align their assets with their liabilities. In the event of a market drawdown, immediate funding needs can be supplied by lower-risk ultrashort fixed income assets, allowing for the prospect of a future recovery in the higher-returning portions of the portfolio. In appreciating/positive markets, the higher tiers should grow relative to

[5] Though private equity tends to have a slower call schedule (thus, committed capital must be managed for longer), the results are substantively similar in each case.

[6] Higher tiers may be higher risk only from a mark-to-market perspective. To the extent that liquidity tiers have a maturity and duration profile aligned with the call schedule, they may be of nearly equivalent (low) risk.

EXHIBIT 5

Example of Liquidity Tiering for Private Debt Investment



SOURCE: Author's calculations and Preqin. The displayed allocation is based on the average call rate by tenure for all private debt funds in the Preqin database from 1992 to 2020 with at least five years of data. See Appendix 1 for more information on the data sample. Hypothetical example for illustrative purposes only.

the remaining uncalled capital, allowing the investor to capture more upside when it is less risky to do so.[7]

We consider four liquidity management strategies. The first is an ultraconservative approach in which the investor holds all committed capital in a money market/T-bill-style investment. Second, we demonstrate the other end of the risk spectrum, in which the investor allocates all committed capital to the PME (high yield debt in this case). Finally, we have two applications of our tiering approach, one based on average call rates from Exhibit 1 and another more conservative approach that tiers not for the average call rates but the highest 10th percentile of call rates each year.

The key risk management concern for uncalled capital is the inability to meet future capital calls. To this end, we consider the expected shortfall: the average difference between the portfolio's value and the remaining uncalled capital whenever the former is less than the latter. In the analysis, we randomly sample call rates each year from their historical ranges for a single GP commitment, as shown in Exhibit 5, with the aforementioned downside PME correlations.[8]

Finally, asset returns are simulated based on forward-looking capital market assumptions, current duration and spread exposures, and historical excess returns for tiering based on Morningstar's ultrashort bond and short-term bond categories[9] and the Bloomberg US High Yield 1–5 Year Index (for PME investments).[10] Asset return assumptions and data are described in more detail in Appendix 2. Once capital is called, we assume it is invested into the private fund. We therefore focus on the realized performance of the committed but uncalled assets. For simplicity, we normalize the initial commitment amount to $10,000.

[7] In this way, liquidity tiering creates dynamics similar to constant proportion portfolio insurance strategies (Black and Jones 1987, among many others). When markets outperform, the portfolio grows relative to the commitments, and the highest-tier/highest-return allocation will grow. If markets sell off and the total balance declines, the safest tiers will tend to grow relative to other assets, reducing the magnitude of any shortfall.

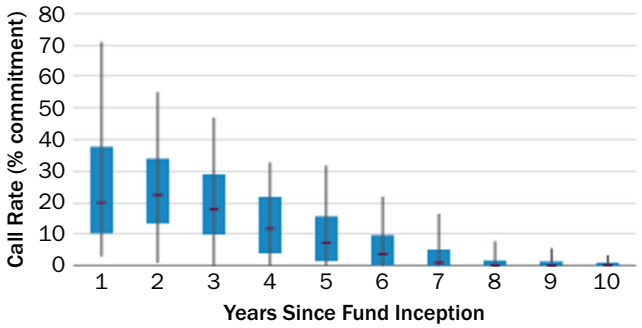
[8] This can be considered conservative as it does not account for diversifying calls by committing to multiple managers as in Exhibit 3.

[9] These assets typically see a nontrivial benefit from active management (Schneider and Chambers 2020 and 2021). We include this benefit in our simulation analysis, as detailed in Appendix 2.

[10] We use short-duration high yield here for simplicity. Depending on the nature of the private investment, different amounts of spread duration and leverage might make for a more comparable PME.

EXHIBIT 6

Dispersion of Private Debt Call Rates



SOURCE: Author's calculations and Preqin. This exhibit shows the distribution of call rates (as a proportion of initial commitment) by tenure for private debt funds and is based on the real-world call performance of all private debt funds in the Preqin database from 1992 to 2020 with at least five years of data. The horizontal lines show the mean, the box indicates the 25th–75th percentile, and the vertical lines show the 5th–95th percentile.
See Appendix 1 for more information on the data sample.

Exhibit 7 shows the remaining wealth net of uncalled commitments after five years for each strategy.

Investors in cash assets take very little risk and receive very little compensation, accruing an average of only $7 in return for every $10,000 of initial commitments over the same five-year period.[11] Investors in the PME (high yield) receive higher compensation, on average, but at a significant risk. High yield returns are expected to be much more volatile, but in the worst 5% of outcomes, these investors would have to find almost 5% more of their initial funds to meet their remaining commitments. Tiering sacrifices some of the PME's expected returns, with excess wealth 16% lower, on average, for the average tiering strategy (and 35% for the conservative strategy). However, alongside this reduction in return, the magnitude of shortfalls also is dramatically reduced. In particular, the average tiering strategy has nearly a 40% reduction in expected shortfalls, while the conservative strategy sees expected shortfalls decline by more than 50% compared with the PME investment. In terms of portfolio returns, the average tiering solution sacrifices only 20 bps to a full PME approach (1.98% versus 2.18%).

One way to think about these benefits is in the context of our earlier example of cash drag in Exhibit 2. While short-duration high yield represents a materially different risk/return profile than a hypothetical investment with a 15% IRR, as in that example, the potential benefits of tiering are still clear. Investing in cash resulted in an efficiency drag of 540 bps at Year Five for private credit; even this relatively low-risk option for the PME reduces the drag below 5% to 460 bps. The average liquidity tiering approach, by comparison, results in a drag more in line with the PME of 470 bps. Tiering allows investors the potential to capture much of the right tail upside of the PME while limiting their downside exposure. Interestingly (and importantly), the tiering dynamics themselves add value: The constant asset allocation portfolio lies inside the average and conservative tiering approaches.

There are several reasons for these results. As we indicated earlier, the investment horizon of the assets is more closely matched to the timing of the anticipated liabilities. In addition, the tiering strategy will dynamically adjust the portfolio to minimize losses; in down markets, the size of the highest-risk tiers will shrink and allow the portfolio to minimize losses. Liquidity tiering allows investors to thoughtfully invest their uncalled capital commitments and potentially reduce the cash drag found in today's markets.

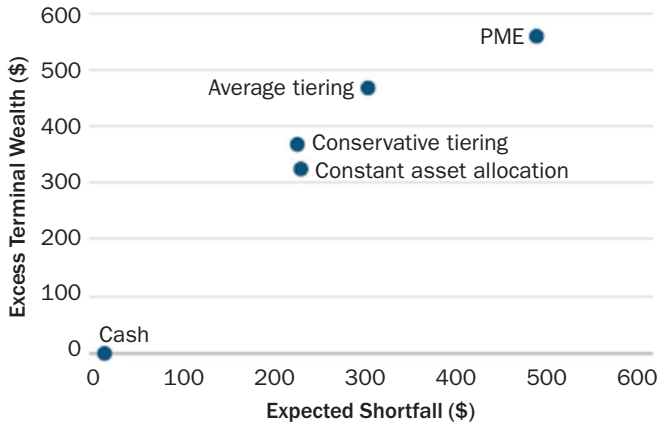
CONCLUSION

The growing use of illiquid investments comes with many potential benefits. Investors gain access to meaningful illiquidity risk premiums, but they face many risk management considerations.

Capital calls are a unique feature of illiquid funds, and they can have an outsized impact on the performance of investors' portfolios. This is important for all illiquid

[11] The current carry on cash is so low, in fact, that the minimal volatility in cash-like assets leads to many circumstances in which remaining wealth cannot quite cover remaining commitments, though, as one would expect, such shortfalls are very small.

EXHIBIT 7
Simulation Results



Statistic	Cash ($)	PME ($)	Constant Asset Allocation ($)	Average Tiering ($)	Conservative Tiering ($)
Mean	7	567	300	475	374
Volatility	20	813	412	647	519
5th Percentile	–21	–681	–290	–446	–248
Tail Loss	–30	–1,096	–511	–757	–588
Probability of Loss	0%	21%	19%	21%	18%
Expected Shortfall	–11	–475	–222	–294	–218

SOURCE: Author's calculations and Preqin. The graph shows the mean balance in excess of remaining commitments after five years, alongside the expected shortfall (realized value conditional on a loss). Tail loss in the exhibit is the average value below the fifth percentile. Simulation assumptions are as detailed in the text. See Appendix 1 for more information on the simulation and data sample underlying the call schedule. "Cash" represents the ICE BofA US 3-Month Treasury Bill Index, while "PME" is the Bloomberg US High Yield 1–5 Year Index. "Constant asset allocation" is a constant blend of the Morningstar Ultrashort Bond Category Index, the Morningstar Short-Term Bond Category Index, and the PME, according to the initial allocation shown in Exhibit 4. "Average tiering" follows the period-by-period allocation from Exhibit 4. "Conservative tiering" follows a similar tiering allocation as "Average tiering" but targets the 90th percentile of annual calls shown in Exhibit 5. The exhibit is provided for illustrative purposes and is not indicative of the past or future performance of any actual product. Hypothetical example for illustrative purposes only.

asset classes, though private equity capital calls tend to be particularly slow. As shown above, it takes an average of five years for 80% of an investor's commitments to PE to be called, approximately two years longer than investors in private debt and private real estate must bear. The return impact of this delay can be substantial. Based on the average pacing of capital calls and distributions and today's low and negative real yields, the cash drag from uninvested funds can be upward of 5% for a fund with an IRR target of 15%.

Increasing the return on uncalled capital can entail larger than expected risks. Not only are committed assets subject to outflows and thus sequence-of-returns risk, but those outflows are also typically correlated with markets. It's not only that capital calls are most likely to occur during drawdowns, but that meeting capital calls when the market is down can crystallize investors' losses and ensure their investments cannot meet their future spending needs.

We address the challenge of cash management for capital calls with a liquidity tiering framework. Using data on the actual behavior of private managers, we show how dynamically managing the portfolio against upcoming calls can realize the potential for materially higher gains than cash, with less risk than PME investments. The dynamics of tiering strategies naturally facilitate upside capture and limit downside risk, and may offer an appealing way for investors to manage committed and uncalled capital.

EXHIBIT A1
Data Details

Asset Class	Number of Funds	Total AUM (& billions)
Private Debt	267	301
Private Equity	1,407	1,846
Private Real Estate	471	421
Total	2,145	2,567

SOURCE: Preqin and author's calculations as of December 2020.

APPENDIX 1

THE PREQIN DATA

In this study we focus on three asset classes within private capital: private equity, private debt, and private real estate. The data cover fund-level cash flow history (a subset of performance data), such as capital calls, capital distributions, and current values, from 1992 to 2020. These funds are concentrated in North America but include funds from Europe, Asia, Australasia, Latin America, the Middle East, and Africa. We include funds of various statuses, from first to sixth close, closed, or liquidated.

We restrict the data sample to funds with at least five years of transaction information (capital calls/distributions/valuations). Exhibit A1 summarizes the number of funds and total assets under management as of December 2020.

Preqin provides data on the alternative assets market, including private capital and hedge funds. The asset classes it covers include private equity, private debt, real estate, hedge funds, infrastructure, and natural resources. Preqin data sources include investors, fund managers, performance, and deal flow, as well as information on compensation, fund terms, and employment.

APPENDIX 2

MORNINGSTAR DATA AND SIMULATION ASSUMPTIONS

To model portfolio risk, we employ a block bootstrap methodology. We start by computing historical returns from January 1997 through March 2021 for the risk factors that underlie each index or portfolio. We then draw four sets of three-month returns within the dataset to come up with a quarterly return number. We repeat this process 25,000 times to simulate a distribution of 25,000 annualized returns across all risk factors. We then use this distribution of outcomes to calculate investment portfolio returns and call rates for the various liquidity management strategies.

Capital calls are simulated according to the distributions over time in Exhibit 6 and are correlated with asset market declines. When the PME declines, call speeds are related to PME returns with the covariance of calls and the PME (as described in the text). Cumulative calls are capped at 100% of the initial commitment.

In the analysis, we examine four primary assets (see Exhibit A2).

For ultrashort and short-term category index proxies, we utilize a regression-based approach of the respective Morningstar category index to characterize active risk versus the relevant benchmark (ICE BofA US 3-Month Treasury Bill Index and ICE BofA 1–3 Year US Treasury Index, respectively). Benchmark returns are based on the current loss-adjusted carry of each index as of June 30, 2021. Forward-looking alpha assumptions use the average alpha over the past 10 years for each category (56 bps for ultrashort and 65 bps for short-term). More information on the category index proxies is included below and in Exhibit A3.

EXHIBIT A2
Asset Class Mappings

Asset	Proxy
Cash and cash equivalents	ICE BofA US 3-Month Treasury Bill Index
Public market equivalent to private debt	Bloomberg US High Yield 1–5 Year Index
Active ultrashort	Morningstar Ultrashort Bond Category Index
Active short-term	Morningstar Short-Term Bond Category Index

SOURCE: Author's calculations.

EXHIBIT A3

Risk Exposure and Active Risk Contribution by Morningstar Categories

Categories	Ultrashort Bond		Short-Term Bond	
Risk Factor*	Exposure	Contribution to Active Risk	Exposure	Contribution to Active Risk
US Duration	0.28	–0.04%		
IG Spread	1.18	0.67%	2.3	1.54%
HY Spread	0.21	0.37%		
EM FX	–0.04	0.10%		
Slope Factors			–0.57	0.07%
Residual		0.52%		0.33%
R^2/Total Tracking Error	63%	1.45%	83%	1.94%

NOTE: *Excludes risk factors with contributions of less than 0.04% of active risk.

SOURCE: Author's calculations as of June 30, 2021.

ULTRASHORT BOND

Ultrashort bond portfolios invest primarily in investment grade (IG) US fixed income issues with typical durations of less than one year. This category can include corporate or government ultrashort bond portfolios, but it excludes international, convertible, multisector and high yield (HY) bond portfolios.

SHORT-TERM BOND

Short-term bond portfolios invest primarily in corporate and other investment grade U fixed income issues, and have durations of one to 3.5 years (or, if duration is unavailable, average effective maturities of one to four years). These portfolios often are attractive to fairly conservative investors because they are expected to be less sensitive to interest rates than portfolios of longer durations.

FORWARD-LOOKING RISK AND RETURN ASSUMPTIONS

Finally, Exhibit A4 summarizes our risk and return assumptions.

Estimated returns for indexes are the current loss-adjusted carry as of June 30, 2021. For information on the estimated return methodology for the ultrashort category and the short-term category, please refer to the details provided above.

We employ a block bootstrap methodology to calculate volatilities. We start by computing historical factor returns that underlie each asset class proxy from January 1997 through the present date. We then draw a set of 12 monthly returns within the dataset to produce an annual return number. We repeat this process 25,000 times to have a return series with 25,000 annualized returns. We use the standard deviation of these annual returns to model the volatility for each factor, and then use the same return series for each factor to compute covariance between factors. Finally, we calculate the

EXHIBIT A4

Forward-Looking Return Assumptions

Asset Assumptions	3-mo. T-Bills	Ultrashort Category	Short-Term Category	PME
Estimated Return	0.0%	0.6%	1.2%	2.4%
Estimated Volatility	0.1%	1.1%	1.6%	4.4%
Sharpe	—	0.50	0.73	0.53%
Duration	0.2	0.2	1.9	1.8

SOURCE: Author's calculations as of June 30, 2021. Cash is represented by the ICE BofA US 3-Month Treasury Bill Index. For the private debt simulation, the public market equivalent is represented by the Bloomberg US High Yield 1–5 Year Index.

volatility of each asset class proxy using the variances and covariances of factors that underlie that particular proxy. For each asset class, index, or strategy proxy, we look at either a point-in-time estimate or the historical average of factor exposures in order to determine the total volatility.

Value at risk (VaR) and conditional value at risk (CVaR) estimate the risk of loss of an investment or portfolio over a given time period under normal market conditions in terms of an average of loss after a specific percentile threshold of loss—that is, for a given threshold of X%, under the specific modeling assumptions used, the portfolio will incur an average loss in excess of the VaR/CVaR X% of the time. Different VaR/CVaR calculation methodologies may be used. VaR/CVaR models can help us understand what future return or loss profiles might be. However, the effectiveness of a VaR/CVaR calculation is in fact constrained by its limited assumptions. For example, assumptions may involve, among other things, probability distributions, historical return modeling, factor selection, risk factor correlation, and simulation methodologies. It is important that investors understand the nature of these limitations when relying upon VaR/CVaR analyses.

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