EDHEC
Infrastructure &
Private Assets
Research Institute

SUMMER
2025

RESEARCH INSIGHTS | EDHEC BUSINESS SCHOOL

EDHEC Infrastructure & Private Assets

Contents

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Introduction

I'm delighted to unveil this special private assets investment edition of the EDHEC Infrastructure & Private Assets Research Institute supplement to Investment & Pensions Europe. In these pages, we share with institutional investors the latest findings from our research team as we focus a rigorous, academic lens on some of the most urgent and complex challenges shaping their investment landscape today.

Our first article is based on a global survey and exposes widespread inconsistencies and conservatism in how institutional investors value unlisted infrastructure assets; most report exit prices well above internal valuations. It highlights governance gaps and methodological fragmentation, and proposes reforms to improve transparency, comparability and alignment with market realities. We make recommendations for reforms to improve accuracy, comparability and investor confidence.

Our second article introduces a dynamic factor model for valuing private companies using actual transaction data, avoiding the biases of appraisals and traditional comparables. By leveraging the PECCS® taxonomy and a global dataset, it enables more accurate, frequent and transparent valuations, aligning with fair value standards and improving benchmarking in private markets. Our model enables the creation of reliable benchmarks, supports high-frequency portfolio valuations and aligns with international accounting standards. It enhances transparency, regulatory compliance and investment decision-making.

Next, we take a dive into market risk in private equities. In this article, we demonstrate how private equity asset prices are systematically influenced by firm-level risk factors such as size, leverage, profitability and maturity, as well as market segment classifications defined by PECCS®. Using transaction-level data and a multi-factor model, the authors show that over two-thirds of price variation can be explained by systematic risks, with valuation multiples and discount rates reflecting these exposures. The findings challenge the notion that private equity risk is unobservable and offer a more accurate framework for valuation, benchmarking and understanding market dynamics in private assets.

Finally, we take a look at the influences of fund size on performance. Our study finds that both small and mega US buyout funds outperform mid-sized peers, with small funds offering the highest alpha but also the greatest return dispersion and risk. Manager incentives and systematic risk exposures help explain these patterns, as successful managers scale into mega funds while smaller funds exploit inefficiencies in the lower end of the market. The findings suggest that alpha generation is possible at both ends of the size spectrum, though driven by different dynamics.

We hope you enjoy reading this special issue and extend our warmest thanks to Investment & Pensions Europe for their invaluable collaboration in bringing this supplement to life.

Timothy Whittaker, Director, EDHEC Infrastructure & Private Assets Research Institute

Fair value or fair guess? Inside the engines of infrastructure valuation

Timothy Whittaker, Director, EDHEC Infrastructure & Private Assets Research Institute

Widespread valuation inconsistencies: **A global survey of 79 institutional investors reveals that unlisted infrastructure assets are often undervalued. Valuation practices vary widely, especially in discount rate construction, terminal value estimation, and responsiveness to market stress.**

Governance and methodological gaps: **Over 60% of investors rely heavily on management forecasts with limited independent verification. Only 32% adjust valuations during market turbulence, and there's no consensus on terminal value or discount rate methodologies, leading to reduced comparability and transparency.**

Impact on investment oversight: **The valuation inconsistencies undermine the reliability of NAVs used for performance monitoring, GP selection, and asset allocation. Misaligned valuations distort risk-return assessments and complicate benchmarking across portfolios and managers.**

Recommendations for reform: **We advocate for standardised valuation protocols, including quarterly revaluations, transparent input disclosures, independent oversight, and the use of market-calibrated, multi-factor discount rate models. These reforms aim to improve accuracy, comparability, and investor confidence.**

The valuation of unlisted assets is foundational for critical financial decisions, including capital allocation, risk management and regulatory reporting. Despite principles-based guidance from frameworks like IFRS 13, ASC 820 and the IPEV Guidelines, day-to-day valuation practices remain opaque and highly discretionary. This article presents the first large-scale empirical study of these practices, based on a global survey of 79 institutional investors and service providers.

Our survey reveals three systemic patterns in the valuation of unlisted infrastructure assets:

- ***Conservatism:*** A significant 76% of respondents reported selling assets at prices above their latest net asset values (NAVs), with typical premiums ranging between 6% and 20%. This suggests that reported fair values often underestimate the true market-clearing prices.
- ***Methodological fragmentation:*** Respondents employ widely divergent approaches to critical valuation inputs, such as discount-rate construction and terminal-value models. This lack of consistency makes comparability challenging.
- ***Governance gaps:*** Over 60% of respondents primarily rely on management forecasts with limited independent challenge. Furthermore, only about one-third (32%) adjust valuations during market turbulence.

Collectively, these findings point to a persistent 'valuation gap' that negatively impacts comparability, obscures risk and weakens oversight in private-market portfolios. The paper concludes by proposing concrete measures to strengthen the link between reported fair values and market prices, and to bolster confidence in infrastructure as a growing asset class within institutional portfolios.

There is a fundamental lack of clarity regarding the valuation of unlisted infrastructure and private assets, despite increasing institutional interest. Fair value accounting frameworks like IFRS 13 and ASC 820 offer principles-based guidance but allow considerable discretion, leading to wide variations in valuation approaches, especially for illiquid and bespoke assets like infrastructure. This absence of detailed empirical evidence on actual valuation practices is a critical blind spot for academic research and investment oversight.

Investors, regulators and asset managers heavily depend on reported NAVs for performance evaluation, risk management and capital allocation. However, concerns persist about the opacity, inconsistency and potential manipulation or bias in valuation processes, especially during volatile market conditions. Understanding these practices is crucial for improving governance and transparency in the private markets.

This article specifically investigates how institutional investors estimate and govern valuations for unlisted assets, with a focus on infrastructure. It uses an industry survey to document practices across key areas:

- Cash flow forecasting
- Discount rate construction
- Terminal value estimation
- Revaluation frequency: The study also explores the influence of governance structures, management inputs and market stress on valuation behaviour.

The results highlight significant fragmentation and inconsistency, with many investors applying conservative assumptions that systematically understate value relative to exit prices. There is limited responsiveness to market changes, and considerable variation in how

discount rates and terminal values are determined. An over-reliance on management forecasts is also widespread, with few mechanisms for systematic challenge. We aim to contribute new empirical evidence, expose governance limitations and provide a basis for improving valuation oversight for various stakeholders, including asset owners, fund managers, auditors and regulators.

Fair value measurement of unlisted assets

Since the introduction of IFRS 13 in 2005 and ASC 820 in 2008, fair value measurement has become a fundamental requirement for financial reporting of unlisted assets like private equity and infrastructure. Fair value is defined by both IFRS 13 and ASC 820 as the price that would be received to sell an asset in an orderly transaction between market participants at the measurement date. Since observable market prices are impossible for unlisted assets, accounting standards allow for a three-tier valuation hierarchy based on available information:

- ***Tier 1:*** Assets with clearly observable market prices.
- ***Tier 2:*** Assets valued using market prices for similar assets (eg, matrix pricing of bonds).
- ***Tier 3:*** Unlisted assets without listed analogues, allowing for internally generated valuations. This article focuses on this third tier.

Due to the subjectivity and complexity in valuing Level 3 assets, additional guidance has emerged from the International Private Equity Valuation (IPEV) Guidelines. These guidelines support fair value as prescribed by IFRS 13 and ASC 820 but are more prescriptive on methods, including:

- ***Market approach:*** Employs multiples from public or recently traded private companies.
- ***Income approach:*** Uses the discounted cash flow (DCF) approach.
- ***Cost approach:*** Measures the investment at the price paid. The study primarily focuses on the market and income approaches. While these methods aim to approximate updated market pricing, the rules allow for broad interpretation of inputs. For instance, IPEV guidelines suggest choosing reasonable multiples but do not specify the number of comparables or recency of transactions, which can lead to opportunistic choices of valuation inputs.

IFRS 13 attempts to mitigate this risk through disclosure requirements, specifically for Level 3 assets. These include disclosing inputs, chosen methodologies, changes in methodology and sensitivity of the valuation to input changes. However, these disclosures do not fully eliminate the potential for opportunistic discretion. Debate persists regarding the reliability of unlisted asset valuations, with research indicating that managerial discretion can be used to manage earnings, especially by underperforming managers seeking to raise new funds. Conversely, top-performing funds may understate valuations and returns.

Fair value accounting, particularly for Level 3 assets, has also been criticised for its opacity and the difficulty investors face in interpreting underlying valuation assumptions. The reliance on complex models and unobservable inputs can obscure the economic reality of asset values, making it hard to assess credibility or compare valuations. Despite these criticisms, recent research suggests that fair value accounting has led to improvements in financial reporting quality for investment funds, reducing historical biases in private fund valuations and enhancing accuracy. Nevertheless, significant gaps remain in how asset managers apply methodologies and the specificity of their disclosures.

Implications for institutional investors

The valuation of unlisted infrastructure assets has direct and material implications for institutional investors, particularly limited partners (LPs), who rely on reported NAVs for:

- Monitoring investments
- Attributing performance
- Selecting general partners (GPs)
- Fulfilling regulatory obligations

NAVs are the cornerstone of investment oversight for LPs, serving as the primary formal updates from GPs. They influence rebalancing decisions, internal reporting and GP performance assessments. However, variability in valuation inputs and timing across managers introduces inconsistencies, reducing comparability and adding noise to oversight processes. Without a standardised framework, LPs must interpret figures based on varying assumptions regarding discount rates, terminal values or market comparables. Inconsistent valuations can also distort performance metrics like IRRs or MOICs, affecting GP selection.

Inconsistent valuation practices also complicate portfolio construction. Asset allocation decisions depend on accurate assessments of risk-adjusted returns, and mispriced infrastructure assets can lead to misallocation. For example, conservative valuations might make unlisted investments appear less attractive, while inflated valuations could obscure risks. Benchmarking performance is further complicated by the absence of standardised practices, as industry indices aggregate self-reported fund data that may be inconsistent, undermining comparability and distorting risk-return profiles used in strategic asset allocation.

To understand industry approaches to valuing illiquid assets, a survey was designed and sent to investment professionals globally. The survey covered:

- Valuation practice
- Inputs to valuation models
- Valuation methodology
- Perceived valuation drivers

The survey was developed based on prior interviews in 2022 and distributed in 2023 and 2024, yielding 79 usable responses. While it included questions on private infrastructure debt, those results were not analysed due to low response numbers and to maintain anonymity.

Survey respondent characteristics

The survey participants represented a diverse range of institutional backgrounds and geographic locations. The majority were affiliated with organisations based in Europe, notably including France (5%), Germany (4%) and the UK (5%). North American respondents were also significant, with representation from the US (5%) and Canada (4%), alongside a notable group from Australia (5%). However, a substantial proportion of participants (57%) did not specify their organisation's head office location.

Respondents' investment focus was predominantly geared toward equity investments in unlisted infrastructure, accounting for 77% of the survey group. A smaller proportion of participants (13%) indicated a combined focus on both debt and equity, while exclusively debt-oriented respondents represented only 10% of the total.

Regarding infrastructure asset strategies, respondents primarily targeted lower-risk, traditional assets categorised as core (25%) and core-plus (23%). Value-added infrastructure followed closely at 22%, whereas opportunistic strategies were rare, comprising only 1% of respondents. Notably, 13% of participants employed alternative classifications such as in-house systems or The Infrastructure Company Classification Standard (TICCS), rather than conventional industry terms.

The organisational types of respondents varied, with asset owners constituting the majority at 55%. Within this group, 30% invested directly in infrastructure assets, while 25% accessed these investments through funds. Additionally, 32% of respondents were affiliated with specialist or multi-asset managers, and 13%

represented valuation service providers.

Lastly, the survey captured insights from professionals holding senior positions, enhancing the reliability of responses. The most frequently reported job title was managing partner (14%), followed by portfolio managers (9%) and participants who described their role as 'other' (10%). These titles suggest respondents possessed substantial insight into their organisations' valuation practices.

Valuation process

The survey examined how regularly institutional investors update valuations and their responsiveness during market stress periods. Regarding valuation frequency, quarterly revaluations were most common, reported by 28% of respondents. Less frequent revaluations, such as semi-annual and annual updates, were each reported by 9% of participants. Only a small minority conducted more frequent valuations, with monthly revaluations at 5% and daily revaluations at 4%. This predominantly slower cadence is a significant concern, as it could impair accurate reflection of asset value fluctuations.

Additionally, the survey identified limited responsiveness to market volatility. Only 32% of respondents proactively revalue assets during periods of market stress, whereas 23% explicitly stated that such events do not trigger revaluation. This lack of responsiveness contributes substantially to valuation smoothing and reduced volatility in reported returns, obscuring true market conditions and complicating effective risk assessment for investors.

Valuation inputs

The survey examined the key factors investors consider critical to the valuation of infrastructure assets and the methods applied in their assessments.

Factors considered relevant

Respondents highlighted several critical factors affecting infrastructure asset valuations. Leverage and its associated cost (14%) and underlying profitability (13%) emerged as the most significant considerations. Market-driven revenue models, the investment lifecycle stage and comparable industry valuations each were identified as relevant by 12% of participants. Notably, long-term interest rates (14%) were considered more impactful than short-term rates (6%). Size, however, was cited as important by only 8% of respondents – a notable deviation from academic research that consistently identifies size as a priced factor, suggesting potential mispricing within the infrastructure investment community.

Perceived relative importance

Respondents ranked industry valuation as the most influential factor in infrastructure asset valuation. This was closely followed by the revenue model, investment stage and profitability. Although there was significant diversity in rankings, no factor was dismissed as irrelevant by any respondent. Interestingly, the characteristics generally recognised in academic literature as priced factors – namely leverage, profitability and growth – were regarded as having only secondary or tertiary importance. Long-term interest rates were positioned as moderately influential.

Expected directional impact

Investors perceived clear directional influences of specific valuation factors:

- Positive impacts were strongly associated with size (77%), profitability (96%), growth prospects (95%) and industry valuation benchmarks (91%).
- Negative impacts were linked with high leverage (62%), early-stage investments (80%), and increases in short-term (100%) and long-term interest rates (82%).
- Mixed views emerged around market-driven revenue models, with 57% viewing this factor positively and 43% negatively, indicating significant uncertainty and variation in investor assessments.

Primary sources of return

Participants identified consistent cash flows as the primary driver of returns (37%), reflecting the traditional attractiveness of stable, predictable income from infrastructure assets. Expectations for growth-driven increasing cash flows followed at 25%, with asset revaluation through capital appreciation recognised by 22%. A smaller proportion (11%) indicated decreasing interest rates as a return source, highlighting its relatively limited role compared to direct income and growth potential.

Valuation methodology

The survey explored the methodologies respondents employ in estimating the value of infrastructure assets, specifically focusing on cash flow estimation, terminal value calculation and discount rate determination.

Cash flow estimation

A majority of respondents (60%) primarily rely on cash flow forecasts provided by management, either directly or by conducting scenario and sensitivity analyses based on these forecasts. An additional 10% of respondents explicitly adjust these management forecasts for potential optimism bias. Only 26% reported independently developing their own cash flow forecasts. Notably, 17% of respondents utilise management forecasts directly without any adjustments, raising concerns regarding the objectivity and accuracy of such valuations.

Adjustments to cash flow estimates vary significantly among respondents, with no standardised method emerging. Specific adjustments included increasing cash flows by reclassifying operating leases as financing expenses (20%), reducing cash flows due to asset impairments from unexpected business risks (30%) and enhancing cash flows based on expected synergies (20%). Additional ad-hoc adjustments are commonly made based on macroeconomic expectations, highlighting considerable inconsistency in the valuation approach.

Regarding the forecast horizon, a majority of respondents (59%) prefer projecting cash flows for the entire economic life of an asset, reflecting the inherently long-term nature of infrastructure investments. However, nearly a quarter (24%) limit their forecasts to the duration of the fund holding the asset, suggesting varied timeframes for valuation approaches among investors.

Terminal value estimation

A significant proportion (68%) of respondents incorporate a positive terminal value in their valuation models, indicating expectations of ongoing value beyond the explicit forecast period. Conversely, 32% do not apply terminal values, reflecting either conservative valuation practices or specific asset characteristics.

Methodologies for calculating terminal values are notably diverse. The zero-growth perpetuity model, a conservative approach, was most frequently employed (29%). Exit multiple approaches based on private comparables (21%) and combined private and listed comparables (13%) were also commonly used. The stable growth perpetuity model accounted for 13% of respondents, while fewer relied exclusively on listed comparables (8%) or assumed a terminal value of zero at the asset's end of life (4%). The absence of a standard method underscores significant fragmentation, complicating comparability and consistency across asset valuations.

Discount rate determination

Opinions regarding the Capital Asset Pricing Model (CAPM) for determining discount rates are sharply divided: 51%

find CAPM suitable, while 46% disagree. This polarisation highlights scepticism regarding CAPM's capacity to accurately capture specific risks and illiquidity premiums associated with private infrastructure.

Despite this divergence, there is an overwhelming consensus (95%) that discount rates should reflect current market conditions, consistent with IFRS and US GAAP fair value definitions. When calibrating discount rates, half of the respondents primarily use recent private transaction data. Listed market equivalents are used by 21%, while 29% utilise alternative sources such as appraisals, broker quotes or internal valuation models.

In terms of comparative private transactions, practices vary significantly. A restricted set (up to five transactions) is preferred by 38% of respondents, while 31% utilise all available market transactions. Additionally, 19% exclude outliers, and 13% use an extended set (up to 15 transactions). The variability in data selection practices further highlights inconsistency across the sector.

The survey identified prevalent flawed practices in CAPM-based discount rate calculations, such as reliance on historical moving averages for risk-free rates, failure to adjust beta for leverage differences in private assets and arbitrary selection of illiquidity premiums. In contrast, the research advocates for a robust multi-factor or risk-premia approach, leveraging current market-observed risk-free rates, empirically estimated systematic factor exposures and market-derived factor premiums. This approach facilitates continuous calibration and methodological rigour.

Accuracy of valuations

The ultimate validation of any valuation method is its alignment with realised market values. The survey indicated a significant gap, with 76% of respondents reporting exit prices exceeding their latest internal valuations. Premiums typically ranged between 6% and 20%, with smaller segments reporting 0–5% (27%) or higher premiums of 21–50% (4%).

The persistence of these premiums underscores systematic conservatism and indicates that existing valuation practices often underestimate true economic value. Such disparities might arise from infrequent valuation updates or inadequate integration of real-time market conditions. These issues significantly reduce valuation accuracy and investor confidence, highlighting the necessity for improved valuation frequency, enhanced methodological consistency and stronger governance to ensure valuations accurately reflect market realities.

Key findings and their implications

The survey identifies several critical insights into current valuation practices, highlighting significant areas needing improvement:

- ***Systematic conservatism:*** The survey reveals that 76% of respondents consistently achieve exit prices above internal valuations, typically by margins ranging from 6–20%. This systematic undervaluation points to conservatism that potentially misinforms investment decisions. Addressing this issue requires methodological enhancements, such as better calibrating valuation adjustments based on historical exit analysis.
- ***Limited responsiveness to market stress:*** Only about a third (32%) of respondents actively reassess asset valuations during periods of market volatility. This limited responsiveness leads to valuation smoothing, which masks genuine underlying risks and volatility, potentially distorting risk assessments and undermining effective risk management.
- ***Uncertainty in discount rate methods:*** There is significant uncertainty about the use of the CAPM, with respondents nearly evenly split on its appropriateness. Despite overwhelming consensus (95%) on the need for market-calibrated discount rates, this uncertainty underscores the need for clearer guidance and standardisation in discount rate practices.
- ***Diversity in terminal value estimation:*** The survey found considerable variability in the methods used to estimate terminal values. With no single approach dominating, comparability across valuations becomes challenging, reducing stakeholders' ability to accurately benchmark and evaluate long-term investment performance.
- ***Over-reliance on management forecasts:*** Over 60% of respondents predominantly rely on management forecasts for cash flow estimations without substantial independent verification or adjustments. This practice introduces significant optimism bias risk, highlighting a clear need for guidelines and processes that encourage rigorous validation and independent review.

The identified variability and inconsistencies significantly impact stakeholders' ability to effectively compare valuations, performance and risks across managers and investment portfolios. This undermines investor confidence and diminishes the efficiency of capital allocation.

Proposed measures for improvement

To enhance valuation reliability and comparability, regulatory bodies and industry standard setters should implement stronger oversight mechanisms and clearer valuation guidelines:

Improving transparency and comparability of valuation inputs

- Anchor discount rates to observable risk-free rates plus explicit, documented premia for known factors such as sector-specific risks, leverage, asset size and maturity.
- Clearly decompose and disclose discount rate components (base rate, risk premia) in quarterly reports.
- Require explicit sourcing of key inputs, including inflation assumptions, revenue forecasts and market comparables, with data accessible to valuation users.
- Include sensitivity ranges (high/low scenarios) alongside key inputs to better illustrate potential risks and valuation variability.

Improving valuation processes of managers

- Mandate regular quarterly revaluations and immediate reassessments following significant market-impact events (eg, refinancing, new contracts, asset completions, macroeconomic shocks).
- Ensure valuations derived from discounted cash flow (DCF) analyses are regularly validated using complementary methods, such as market multiples or recent transaction benchmarks.
- Establish valuation committees to oversee all significant valuation adjustments (greater than 5%), ensuring adherence to robust valuation procedures.
- Conduct annual benchmarking of valuations through independent third-party evaluations.

The survey underscores a critical need for enhanced governance structures and standardised valuation protocols. By adopting these proposed measures, the valuation process for unlisted infrastructure assets can achieve greater transparency, accuracy and comparability, fostering stronger investor confidence and more effective capital market operations.

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The valuation of private companies:

asset valuation and the dynamics of private markets

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Problem with traditional valuation: **Investors can struggle to obtain reliable real-time valuations for private companies. Starting points often rely on appraisals or comparable transactions, which are biased, infrequent and lack transparency and fail to reflect real-time market conditions.**

Proposed factor model solution: **This article introduces a dynamic, transaction-based factor model that uses actual deal data and a multi-dimensional classification system (PECCS®) to model transaction prices. This model captures time-varying investor preferences and avoids the biases of traditional methods.**

Empirical validation: **Using a global dataset of over 5,400 private equity transactions, our model identifies key valuation drivers – such as size, profitability, leverage, sector and market conditions – and demonstrates high predictive accuracy with minimal error across in- and out-of-sample tests.**

Practical applications: **Our model enables the creation of reliable benchmarks, supports high-frequency portfolio valuations and aligns with international accounting standards. It enhances transparency, regulatory compliance, and investment decision-making.**

Executive summary: The core problem and proposed solution

Investors face significant challenges when valuing private companies due to a lack of reliable valuation histories, making it difficult to construct accurate and representative private market indices. Existing benchmarks often rely on appraised valuations, which are susceptible to biases such as smoothing, staleness and poor representativeness, failing to reflect the full universe of private companies or current market information. Additionally, comparable analyses (comps), frequently used by investors, depend on sparse, noisy and biased transaction data, which reduces their effectiveness.

This article introduces a factor model-based solution that does not depend on appraised valuations or suffer from the biases of raw transaction data. Our model converts noisy and biased transaction data into meaningful insights through:

- Incorporating comprehensive risk factors captured within each transaction, unlike comps which rely solely on price data.
- Utilising dynamic linear models (DLMs) to estimate factor premiums that vary over time, effectively capturing shifts in investor preferences, such as changing views on company size during economic downturns. This approach produces true and unbiased factor price estimates even when calibrated with biased samples.
- Enhancing existing private company data through the PECCS® (PrivatE Company Classification Standard) taxonomy. This rigourous classification scheme extends beyond industrial activity to encompass multiple dimensions of risk, including lifecycle phase, revenue model, customer model and value chain. For instance, PECCS® effectively captures the distinct risk profiles of startups and subscription-based businesses, enabling the model to manage a broad spectrum of risks despite limited data.

This factor model lets investors value private companies more accurately, bypassing the pitfalls associated with appraisal data and arbitrary raw transaction data. It offers a flexible and robust framework that enables the creation of reliable benchmarks comparable to those available in publicly traded markets.

Furthermore, the proposed model aligns closely with international guidelines, such as the International Private Equity and Venture Capital Valuation (IPEV) standards, which define fair value (FV) as the estimated transaction price in an open market. Accounting standards including IFRS and US GAAP also advocate for FV accounting, with IFRS 9 specifically mandating mark-to-market valuation for financial assets. We emphasise that the long-term holding of assets does not negate the requirement to apply FV principles, which must reflect observable market values. A factor model incorporating actual transaction data is the sounded route way to determine FV for private companies.

Recent regulatory developments, such as the SEC's 2023 regulations for private market funds in the US and the FCA's 2023 review of valuation practices in the UK, highlight the growing significance of private market valuation accuracy and transparency. Despite concerns about

compliance costs, these regulatory initiatives underline the need for improved valuation and disclosure practices in private markets.

Our factor model relies on actual transaction data, rather than appraised or estimated valuations, and specifically addresses total private company valuation (price-to-sales ratio), considering the company's overall performance as foundational to valuing any specific security within its capital structure.

The model utilises a robust, global dataset of private company transactions spanning over two decades. Factors included in the model are informed by academic research, surveys of private equity managers and specific characteristics of private markets guided by the PECCS® taxonomy. Key findings indicate that smaller, profitable, more leveraged, labour-intensive, innovative and younger companies generally receive higher valuations. Market conditions significantly influence valuations, with higher valuations observed during periods of high public market or industry valuations, lower term spreads, higher market liquidity and when value stocks outperform growth stocks. Companies in sectors such as financial services, healthcare, natural resources and real estate receive valuation premiums, while retail companies typically experience valuation discounts. Subscription revenue models, direct consumer sales and hybrid product/service offerings also contribute to higher valuations, with these effects varying over time.

Diagnostic tests demonstrate the model's robustness, as predictions closely match actual observed transactions, and errors are consistently small and normally distributed across both in-sample and out-of-sample tests. Segment-level valuations within PECCS® classifications also show high accuracy. Predicted valuation metrics are 'de-smoothed', exhibiting volatility comparable to public market benchmarks and correlating strongly with them, further alleviating concerns about artificial variability.

In summary, our robust factor model, complemented by the PECCS® taxonomy, provides precise, reliable and frequent valuation metrics at a granular, segment-level. It facilitates calculating 'shadow prices' for diverse private companies, enabling the construction of accurate benchmarks. This method addresses the traditional issues of subjectivity, behavioural biases and data sparsity inherent in private market valuations.

Introduction: the private assets landscape and valuation gaps

The global private markets, currently valued at approximately $11.7trn, constitute a substantial part of the financial markets, although still significantly smaller than public equities ($105.1trn). Private equity is the dominant investment vehicle, representing 65.1% of total assets under management in private assets. Given their significant contributions to GDP, employment and innovation, accurately valuing private companies is crucial for informed portfolio screening, asset allocation, performance monitoring, and compensation decisions.

Valuation challenges

Current methods predominantly rely on appraised valuations, which often incorporate unrealised profits and introduce considerable subjectivity. This reliance adversely affects key decisions such as asset allocation. Moreover, fund manager compensation, particularly carried interest, depends heavily on these valuations. Institutional investors, despite their sophistication, often lack sufficient data to independently determine the FV of private assets, forcing reliance on general partners (GPs) and external service providers for appraisals of illiquid and rarely traded private companies.

Key issues with existing valuation practices include:

- ***Delayed incorporation of Market information:*** GPs typically provide valuations quarterly, with guidelines allowing significant discretion. This reporting lag and the associated annual management fee structures reduce incentives for timely, mark-to-market adjustments.
- ***Absence of comparable performance metrics:*** Due to illiquidity, accurately computing returns and volatility is challenging, prompting reliance on internal rates of return (IRRs), which can be manipulated and differ significantly from actual investor returns.

Importance of fair value

Ignoring FV because of the long-term holding nature of private assets is fundamentally flawed. Accounting standards such as IFRS and US GAAP mandate fair-value accounting, emphasising market-based valuation regardless of investment horizon. IFRS 9 specifically requires marking financial assets to market values, eliminating historical cost accounting. FV is explicitly defined as the exit value at the time of evaluation, independent of the holding period, and prioritises observable market inputs.

IPEV guidelines align closely with these accounting standards, establishing consistent frameworks for valuing private capital investments. Additionally, US regulations like ASC 820 categorise private company investments as Level 3 assets, highlighting their illiquid nature and reliance on unobservable inputs. This makes a factor model calibrated using actual transaction data the most compatible for determining FV in compliance with these standards.

Consequences of valuation gaps

Inadequate valuation practices have significant real-world implications:

- ***Return smoothing and performance distortion:*** Delayed valuation updates artificially smooth returns, creating misleading performance perceptions. This can lead investors to underestimate risk, especially in volatile markets.
- ***Ephemeral down rounds and complex structures:*** Reluctance to reduce valuations impairs private companies' ability to secure necessary growth financing, prompting overly complex deal structures and potentially risky management decisions.
- ***Denominator effect:*** During public market downturns, private asset valuations hold steady, breaching asset class thresholds and limiting capital inflows, which reduces investor diversification and potentially prompts distressed asset sales.
- ***Diverging secondary market valuations:*** Private companies staying private longer increases secondary market activity, where GP-led secondaries often match reported NAVs, while LP secondaries occur at significant discounts. These discrepancies distort the risk-return perspective, impairing efficient capital allocation.

Limitations of public benchmarks

Public markets are generally unsuitable benchmarks for private companies due to:

- ***Reduced public company listings:*** A declining number of US public listings results in less diversity, making public indices poor proxies for private company valuations.
- ***Leverage differences:*** Private equity typically employs higher leverage, making public indices inadequate indicators of private company risk.
- ***Diversification challenges:*** Diversifying private company portfolios is more expensive and complex compared to public equities, leading to more concentrated holdings.

Proposed factor model solution

To address these issues, our paper proposes a factor model approach leveraging actual private company

transaction data. This model:
- Estimates unbiased factor prices using a DLM that accounts for time-varying market conditions;
- Utilises a large, global dataset of transactions to identify optimal, influential valuation factors through statistical analyses; and
- Employs the PECCS® taxonomy, which classifies companies by dimensions such as industrial activity, lifecycle phase, revenue models, customer profiles and value chains, significantly enhancing valuation accuracy.

Empirical results indicate smaller, profitable, innovative and younger firms typically command higher valuations. Market conditions also have a significant influence on valuations. Companies in financial, healthcare, natural resources and real estate sectors generally enjoy premium valuations, whereas retail companies face discounts. Subscription-based models and direct consumer-focused business models also receive higher valuations.

Diagnostic tests validate the model's robustness, demonstrating precise alignment with actual transactions and effectively eliminating artificial smoothing effects.

Thus, this factor model, enhanced by the PECCS® classification system, provides reliable, frequent, and granular valuation metrics, in the form of accurate factor premiums. When applied to other unlisted companies, these factor prices overcome traditional private market valuation challenges and facilitate the construction of accurate benchmarks for effective investment decisions.

Private market valuation is always about models

In public markets, investors can readily access transaction prices, making it straightforward to evaluate holdings and estimate realisable values upon exit. In contrast, private markets typically lack recent observable transaction prices, and the reported valuations may not reflect actual realisable values. Consequently, accurate valuations in private markets depend heavily on valuation models. Whether explicitly stated or not, any valuation approach inherently relies on certain assumptions and a theoretical framework – essentially, a model. The significance of a well-structured model lies in its ability to convert sparse, biased, noisy and limited private market data into meaningful insights for investors.

Key attributes of a good valuation model

Effective valuation models share specific formal and technical characteristics:

Formal characteristics
- ***Theory-based:*** Valuation models should be rooted in formal theoretical frameworks rather than ad-hoc methods. For example, discounted cash flow (DCF) models rely on the fundamental principles of time-value of money and risk-return trade-offs.
- ***Arbitrage-free:*** The model should produce valuations that eliminate opportunities for riskless profit. For instance, DCF equates asset value with the present value of its expected future cash flows.
- ***Accounting standards compliance:*** Models must conform to established accounting guidelines such as ASC 820 and IPEV, ensuring alignment with recognised industry and accounting standards.
- ***Robust taxonomy framework:*** Models should employ a rigorous taxonomy for categorising private companies, enhancing valuation accuracy through precise and granular definitions.

Technical characteristics
- ***Robustness:*** Effective models consistently yield low prediction errors both in-sample and out-of-sample, are reproducible and provide stable estimates given identical inputs.
- ***Explicit documentation:*** Clear, verifiable documentation of model structure and assumptions, along with measurable inputs, enables objective and transparent valuation.
- ***Parsimony:*** Given the inherent limitations of private market data, an effective model must be parsimonious, maximising its explanatory power from limited inputs.
- ***Predictive capability:*** Good models produce reliable valuation estimates based on observable and computable inputs, such as factor loadings and factor prices.
- ***Frequent updates:*** Effective valuation models enable frequent updates (eg, monthly or daily), requiring inputs that are regularly observable.

The proposed factor model in our paper is compared with traditional approaches, including DCF and comparable analyses (or comps), demonstrating equal or superior performance across all criteria.

Limitations of traditional valuation approaches

Common valuation practices face significant challenges:

Market-based approaches (comps analysis)

Comps methods estimate valuations based on similar publicly listed peers or recent transactions, implicitly assuming similar financial characteristics between comparable companies. However, this approach faces problems:
- ***Systematic differences:*** Known differences between companies are frequently unaccounted for, resulting in subjective and problematic adjustments.
- ***Limited inputs:*** Comps primarily use price multiples, ignoring comprehensive available data and allowing biases from selectively chosen comps or outdated transactions.
- ***Ad-hoc adjustments:*** Informal adjustments based on subjective criteria (e.g., illiquidity, size, leverage) can lead to misleading valuations.

Income-based approaches (DCF)

DCF methods, although grounded in theory, are practically problematic due to:
- ***High input dpecificity:*** The necessity for detailed future revenue, expense and investment forecasts introduces uncertainty and high flexibility, enabling reverse-engineering of desired valuations.
- ***Incorrect discount rates:*** Common practice of using fund target IRRs overlooks company-specific risk, resulting in inaccurate valuations.

Frequency of valuations

Current valuation frequencies (quarterly or semi-annually) are insufficient for effective asset allocation decisions, driven by high costs and minimal regulatory pressure. Low-frequency valuations misrepresent private markets as overly stable, thereby distorting risk perceptions.

Performance measurement issues

Internal rates of return (IRRs)

IRRs, despite widespread use, suffer from:
- ***Methodological flaws:*** Potential for multiple solutions and unrealistic reinvestment assumptions;
- ***Blending realised and unrealised values:*** Combining realised cash flows with estimated valuations reduces accuracy; and
- ***Timing discretion:*** GPs can manipulate IRRs by strategically timing cash flows, distorting true performance.

Public market equivalent

Public market equivalent methods, designed to mitigate IRR and multiple on invested capital issues, are unreliable due to sensitivity to market volatility and timing differences, potentially undervaluing managers' market timing skills.

Improving valuation methods

Accurate valuations significantly impact investment outcomes. Improving valuation practices should address:

- ***Discount rate selection:*** Employing tailored, sector-specific and dynamic discount rates better reflects underlying risks.
- ***Company-level valuations:*** Transitioning from aggregated fund-level valuations to standardised, company-specific valuations reduces inconsistencies, addresses contractual variations and mitigates the sparseness issue arising from infrequent transactions.

Advantages of the proposed factor model approach

Our proposed factor model approach significantly enhances valuation practices:

- ***Converting sparse data:*** Transforms weak transaction data into robust information through dynamic modelling;
- ***Eliminating subjectivity:*** Formal modelling based purely on transaction data eliminates subjective valuation adjustments;
- ***Comprehensive risk control:*** Explicitly controls observable company characteristics, quantifying their impact on valuations;
- ***PECCS® taxonomy:*** Offers an advanced private company classification, capturing multi-dimensional risk factors absent from traditional public classifications;
- ***Addressing data sparseness:*** Incorporates dynamic, historical data to mitigate valuation sparseness; and
- ***Enhanced robustness and precision:*** Employs extensive transaction datasets for reliable, unbiased estimates with minimal error.

Ultimately, this robust factor model, supported by the PECCS® classification, delivers accurate, frequent and precise valuation metrics, addressing traditional private market challenges and enabling better investment decisions.

Transaction-based pricing models

Transaction-based pricing models address the limitations inherent in traditional valuation methods by utilising formal statistical techniques based on actual transaction data. This approach helps mitigate issues such as smoothing effects and delayed reporting commonly associated with appraised values.

Repeat sales indices

Repeat sales indices, frequently employed in real estate markets, estimate returns by focusing on assets sold multiple times. While effective in isolating price movements from asset-specific characteristics, this method is less suitable for private company valuation. The dynamic nature of private companies, combined with the rarity of repeat transactions, limits the method's capacity to accurately capture valuation changes or account for evolving characteristics.

Hedonic pricing models

Hedonic pricing models, also widely applied in real estate, determine asset values based on internal features and external market factors. When calibrated using transaction data, these models can effectively estimate asset prices. For instance, Blanc-Brude and Tran (2019) utilised a DLM to evaluate unlisted infrastructure prices, incorporating time-varying factor prices. Adopting a similar dynamic estimation approach for private companies, while selecting a concise set of key factors, can effectively correct biases from infrequent transaction data and filter out noise, providing reliable valuations.

Key factors affecting private company valuation

Our paper examines several systematic factors considered essential for accurately valuing private companies, incorporating economic rationale and specific features of private equity:

Size

Size is a widely recognised factor influencing asset valuations. Generally, smaller private firms, viewed as riskier, less liquid and limited in financing options, command lower valuations. In private markets, however, the relative liquidity of smaller firms may be higher than larger firms as the latter require a significant capital outlay. Moreover, empirical observations show smaller buyout funds frequently achieving higher IRRs, indicating complexities in size-related valuation dynamics.

Leverage

Financial theory suggests that highly leveraged companies pose greater risk, thus requiring higher returns. Empirical results vary, and leverage in private equity often signals complex scenarios, such as anticipated returns, maturity stages or investment opportunities of target firms, complicating its direct impact on valuation.

Growth

Research by Fama and French (1992) indicates value stocks typically offer higher returns than growth stocks, attributed to risk or market inefficiencies. Similar principles apply to private markets, where high-growth companies, sensitive to economic cycles and prone to mispricing, typically attract higher valuations.

Profitability

Profitable firms generally exhibit higher valuations and returns (Novy-Marx [2013]). This correlation, though seemingly paradoxical, is justified by profitability signalling productive assets and potentially higher required returns. Profitability thus emerges as a crucial valuation factor for private companies.

Market conditions

Transaction valuations in private markets are significantly influenced by prevailing market conditions, such as economic health, public market volatility, interest rate environments and macroeconomic indicators like GDP growth. These external conditions substantially impact private company valuations.

Age

Younger firms often face greater valuation uncertainty due to limited historical data and increased information asymmetry, potentially leading to valuation discounts. Conversely, they might also attract speculative investor interest, emphasising the need for careful empirical evaluation.

Human capital

Effective management of human capital is vital for value creation in private companies. While extensive labour forces can introduce higher coordination complexities, they also present significant restructuring opportunities for private equity firms to enhance value through strategic management practices.

Technology

Innovation significantly contributes to economic growth and is pivotal for private companies, particularly under private equity ownership, which often enhances innovation's commercial viability. Technological innovation thus serves as a key valuation determinant.

Industry concentration

Companies in highly concentrated industries generally experience lower risk due to barriers to entry and reduced innovation incentives, resulting in higher valuations. The specific market share of a company within its industry can further indicate its valuation sensitivity.

Transaction characteristics

- ***Add-on transactions:*** Acquisitions by portfolio companies signal strategic intent and potential synergies, significantly influencing valuations.
- ***Publicly listed targets:*** Acquiring publicly listed firms typically involves higher valuations due to better information transparency and the absence of

private company discounts.

- ***Ownership retention (roll-along stakes):*** When previous investors retain stakes, valuations reflect factors such as aligned incentives, lower immediate cash requirements or management complexities.

Surveys among private equity fund managers highlight growth, profitability and revenue as primary factors positively influencing valuations.

PECCS® TAXONOMY

The PrivatE Company Classification Standard (PECCS®) provides a detailed, multi-dimensional taxonomy specifically tailored for private companies (PECCS [2023]), encompassing:

- Industrial activity
- Revenue model
- Lifecycle phase
- Customer model
- Value chain characteristics

In summary, systematically employing these factors within a structured, transaction-based pricing model ensures more accurate, transparent and actionable valuation insights for private market investors.

Data

Sample construction

The study sources private equity investment data in private companies from PitchBook™, starting from 1999 to ensure a sufficient number of yearly observations.

- ***Preferred valuation metric:*** The price-to-sales (P/S) ratio is favoured over price-to-Ebitda (P/Ebitda) because Ebitda can be negative – rendering P/Ebitda meaningless – and private companies often apply subjective adjustments to Ebitda, reducing comparability. By focusing on valuation via P/S, the study maximises data utilisation.
- ***Filtering criteria:*** Transactions must be completed private equity investments (excluding PIPEs) with a minimum deal size of $10m, involving private companies with recent sales exceeding $5m, and no missing key deal or financial data. Outliers – transactions with P/S ratios in the top or bottom 5% – are excluded to better capture typical deals. After filtering, the sample consists of 5,438 global transactions between 1999 and 2022.

Sample distribution

The sample is geographically diverse, with the UK and US representing 26.7% and 25.2% of transactions by count, respectively; other European and Central Asian countries account for 31.3%. By transaction size, the US dominates with over 51.3% of aggregate deal value. Most deals fall in the $1.5bn to $5bn range (30%), while mega deals above $10bn account for 19%. Sector-wise, information and communication (26%) and manufacturing (22%) lead in deal counts. Over time, these sectors consistently represent the largest share of deals, with information and communication transactions generally having higher average deal values as shown in figure 1. Figure 2 shows the distribution of the log-transformed P/S ratio, and it approximates a normal distribution once outliers are excluded.

Figure 1. Transaction sample distribution by value and PECCS® activity

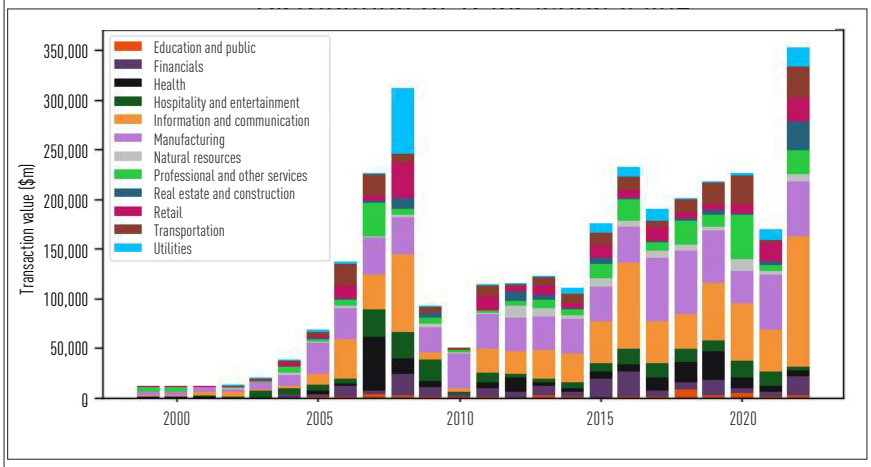
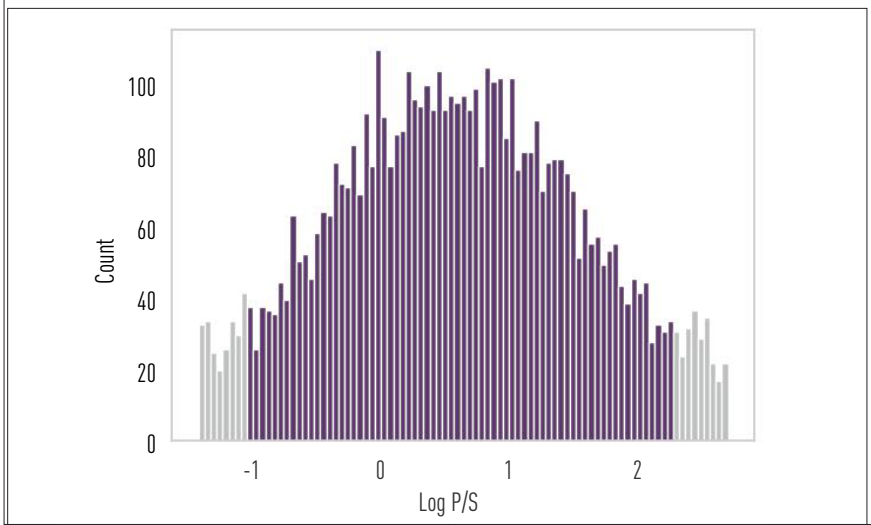


Figure 2. Transaction sample valuation distribution



Explanatory variables

Our study proposes a set of explanatory variables reflecting financial characteristics of private companies and private market dynamics, many of which private equity firms intuitively consider during valuation. Although we test an expansive list of potential explanatory variables, we intend to rely on econometric methods to parsimoniously select among the proposed variables:

- ***Size:*** Logarithm of sales.
- ***Book leverage:*** Logarithm of a constant plus total debt divided by total sales.
- ***Growth:*** Revenue growth rate.
- ***Profitability:*** Ebitda-to-sales ratio (with adjustments for alternate profit measures).
- ***Market valuation factor:*** Logarithm of the P/S ratio of the value-weighted CRSP index, orthogonalised relative to the asset's industry valuation factor.
- ***Industry valuation factor:*** Logarithm of the P/S ratio of stocks within the same PECCS® activity subclass in the CRSP index.
- ***Age:*** Logarithm of a constant plus the difference between transaction year and founding year.

- ***Labour intensity:*** Logarithm of employee count relative to sales.
- ***Market share:*** Logarithm of a constant plus the ratio of private company revenue to the sum of revenues from public firms in the same PECCS® activity class plus the private company's revenue.
- ***Patent:*** Indicator variable equal to 1 if the company has one or more active or pending patents.
- ***Deal leverage:*** Logarithm of a constant plus debt incurred during the transaction relative to company sales.
- ***Herding:*** Proportion of deals in the target company's PECCS® activity class relative to all sample deals in the prior year.
- ***Dry powder:*** Logarithm of annual committed but uncalled capital (dry powder) normalised by the company's sales.
- ***PE backing:*** Indicator variable equal to 1 if existing ownership includes a private equity investor.
- ***Long-term interest rate:*** Logarithm of a constant plus the long-term interest rate in the country of the company's headquarters.
- ***Term spread:*** Logarithm of a constant plus the difference between 20-year and three-month government securities rates.
- ***Transaction characteristics:*** Indicator variables for whether the target is a public company, if the deal is an add-on transaction and percentage ownership sought (control).
- ***Additional market variables:*** Logarithm of the VIX index, public market volatility (standard deviation of monthly returns on CRSP value-weighted indices), Fama-French five factors (value, size, momentum, profitability, investment), Amihud and Mendelson (1986)'s price impact (market and industry level) and market trading volume.
- ***Private size factor:*** Quarterly difference in P/S ratios between smaller and larger private companies.
- ***Macroeconomic indicators:*** GDP growth, CPI inflation, forex exchange rate changes and an indicator for emerging economies.
- ***Sector/activity differences:*** Industry concentration (Herfindahl-Hirschman index), text-based similarity with other private companies and a high-technology industry indicator.
- ***PECCS® indicators:*** Binary variables for all 12 activity classes, three lifecycle phases, four revenue models, two customer models and three value chains defined by the PECCS® taxonomy.

All variables are constructed using information available prior to the transaction date to avoid look-ahead bias.

Summary statistics

Table 1 presents descriptive statistics for these explanatory variables. Pairwise correlation analyses indicate minimal multicollinearity concerns. The P/S ratio tends to decrease somewhat steadily with company size and increase with deal leverage, while other variables do not display clear monotonic relationships.

Empirical results

The empirical approach

Our econometric framework is designed to make use of variables that have statistical and economic value in explaining the transaction valuation, rather than using all the variables. We prioritise explanatory power on the valuation, but adaptations can also rely on fewer variables and get similar results without considerable loss of explanatory power. Detailed information about our empirical approach and detailed results are available in Selvam and Whittaker (2024).

Our framework consists of three stages:

- ***Classification of variables:*** Variables are divided into 'required' (eg, size, leverage, market valuation), whose relationship with private company valuation is well-established, and 'optional' variables.
- ***Variable selection:*** Using econometric methods such as Forward Stepwise Selection, we select optional variables that meaningfully improve the model. We also allow polynomial specifications of the variables to accommodate non-linear effects. Finally, for interpretability, we use a principal component method to select fewer variables that explain the raw valuations better.

Table 1. Descriptive statistics of transaction sample

Number of observations = 5,438							
Variable	**Mean**	**Standard deviation**	**Median**	**Variable**	**Mean**	**Standard deviation**	**Median**
P/S*	2.76	2.73	1.78				
Key explanatory variable							
Size*	463.9	1,760.3	98.6	Market valuation*	0.95	0.88	0.70
Growth*	0.47	0.79	0.66	Industry valuation*	1.82	1.67	1.28
Profitability	0.04	0.1	0.04	Term spread*	0.02	0.06	0.02
Book leverage*	0.61	0.26	0.63				
Optional explanatory variable							
Age*	35.40	34.41	23.00	Public co	0.59	0.49	1.00
Patent	0.26	0.44	0.00	Similarity	0.12	0.15	0.06
Market share*	0.10	0.16	0.04	Size factor	0.01	0.30	0.01
Deal leverage*	0.21	0.17	0.18	Value factor	-1.22	13.40	-1.85
Herding*	0.07	0.09	0.04	Momentum factor	-0.14	3.17	-0.26
PE backing	0.62	0.51	1.03	Profitability factor	2.81	20.24	2.96
Long-term interst rate*	0.05	0.02	0.05	Investment factor	0.27	4.90	0.24
Industrial concentration*	1,186.4	1,011.8	857.3	Size private factor	1.35	0.64	1.24
Forex change	0.01	0.04	0.01	Dry powder*	1.63	2.02	0.64
VIX*	18.32	5.79	16.68	Market volatility*	0.04	0.02	0.04
GDP growth	0.10	0.03	0.10	Market price impact*	0.00	0.00	0.00
CPI growth	0.02	0.01	0.02	Sector price impact*	0.00	0.00	0.00
Labour intensity*	13.89	34.57	4.02	Hitech	0.23	0.42	0.00
Control	0.71	0.01	1.00	Emerging country	0.03	0.17	0.00
Add-on	0.17	0.38	0.00				
PECCS® indicators							
Activity Education & public	0.01	0.11	0.00	*Lifecycle* Mature	0.29	0.45	0.00
Activity Financials	0.11	0.32	0.00	*Lifecycle* Growth	0.29	0.45	0.00
Activity Health	0.07	0.25	0.00	*Lifecycle* Startup	0.42	0.49	0.00
Activity Hospitality & entertainment	0.06	0.24	0.00	*Revenue model* Production	0.68	0.47	1.00
Activity Information & communications	0.18	0.39	0.00	*Revenue model* Advertising	0.08	0.27	0.00
Activity Manufacturing	0.32	0.47	0.00	*Revenue model* Reselling	0.15	0.35	0.00
Activity Natural resources	0.10	0.30	0.00	*Revenue model* Subscription	0.13	0.33	0.00
Activity Professional & other services	0.09	0.28	0.00	*Customer model* B2C	0.64	0.48	1.00
Activity Real estate & construction	0.03	0.17	0.00	*Customer model* B2B	0.36	0.48	0.00
Activity Retail	0.05	0.23	0.00	*Value chain* Products	0.47	0.50	0.00
Activity Transportation	0.05	0.23	0.00	*Value chain* Services	0.41	0.49	0.00
Activity Utilities	0.02	0.13	0.00	*Value chain* Hybrid	0.07	0.26	0.00

* Indicates the variables, when used in regressions, are subject to log or other transformations

● ***DLM:*** The final model – including required variables and selected variables – is estimated with time-varying coefficients. This approach captures evolving investor preferences and corrects for serial correlation in valuation errors. Coefficients are modelled as autoregressive processes and estimated using Bayesian methods, allowing the model to update factor price estimates dynamically as new transaction data arrive, effectively extracting unbiased signals from noisy data.

Factor estimation results

Ordinary least squares (OLS) regressions are a common tool for analysing data, but they come with certain limitations when applied to private company valuations. These valuations often show serial correlation – meaning today's valuation is related to past valuations – which violates one of the key OLS assumptions that observations are independent. Moreover, OLS assumes that the relationship between valuation factors and outcomes is constant over time. However, in reality, investors' preferences and the impact of these factors on valuation change as markets evolve.

In the initial OLS analysis using only essential variables such as company size, growth, profitability, leverage, market valuations, and various industry indicators (known as PECCS® classes), the results aligned well with intuition, as shown in table 2. Smaller, more profitable, and more highly leveraged companies tended to have higher valuations. Valuations were also higher when public markets, especially those in similar industries, were performing well, and when economic indicators like term spreads were narrow, suggesting favourable borrowing conditions.

Table 2. OLS regression of transaction valuation

Explanatory variables	Estimate (t-statistic)	Std error
	Dependent variable: log (P/S)	
Intercept	3.246** (2.59)	1.255
Size	-0.102*** (–11.23)	0.009
Growth	0.005 (0.18)	0.028
Profitability	0.007*** (15.37)	0.000
Book leverage	-0.066*** (–6.78)	0.010
Market valuation	0.067*** (5.83)	0.011
Industry valuation	0.074*** (10.55)	0.007
Term spread	-3.309** (–2.19)	1.783
PECCS® indicators	*Included*	
Observations	5,438	
Adjusted R^2	0.205	

***/**/* denotes statistical significance with p-value < 0.01, <0.05, and <0.1, respectively.

Table 3. Model estimation summary

Step	Method	No of regressors	Adjusted R^2	AIC	BIC
1	Only PECCS™ indicators	19	0.081	14,260	14,390
2	Only use required variables	26	0.205	13,470	13,650
3	Forward stepwise selection	35	0.276	12,980	13,210
4	Polynomial specifications	5,127	0.355	12,160	14,660
5	Lasso feature selection	39	0.289	12,880	13,140
6	Principal component analysis (PCA)	34	0.263	13,080	13,310

Interestingly, leverage showed a positive effect on valuation, which might be because stronger assets can safely carry more debt – a potential signal of quality. When looking at industry classifications (PECCS® coefficients are not reported in table 2 for brevity), firms in health, financial services and natural resources sectors were valued higher than those in manufacturing. Conversely, retail and hospitality businesses generally received lower valuations. Startups stood out with notably higher valuations compared to mature firms and companies with subscription revenue models or consumer-focused customer bases also commanded premiums. Services tended to be valued more highly than product-based companies. This initial model explains about 20% of the variation in valuations.

Next, we expand the model by exploring optional variables and use a stepwise method to pick the most important ones, improving the model's explanatory power. Introducing nonlinear effects – such as squared terms and interactions between variables – further enhanced the model's performance, indicating that relationships between factors and valuations are not always straightforward.

To refine the model further, we apply a Lasso regression, a technique that helps identify the most relevant predictors while avoiding overfitting. Cross-validation determines the optimal degree of shrinkage to balance accuracy and complexity. Because many predictors are correlated, we also perform a principal component analysis to summarise them into a smaller number of composite factors that capture most of the variation without redundancy. The performance of the models at each sequential step in our method is presented in table 3.

Table 4 presents the final OLS model that includes the core variables, selected optional variables and principal components. This refined model revealed that companies with intensive labour forces, holding patents, operating in high-tech sectors or being younger in age tend to have higher valuations. Valuations also rose during times when public equity markets were more liquid and the public market value premium was lower. On the other hand, valuations dropped when investors sought more control in transactions or when deals were add-ons to existing portfolio companies. This model explained about 26% of valuation variation and showed no serious issues with multicollinearity.

Table 4. Final OLS model

Explanatory variables	Estimate (t-statistic)	Std error
	Dependent variable: log (P/S)	
Intercept	4.484*** (3.64)	1.231
Size	-0.069*** (–5.60)	0.012
Growth	-0.013 (–0.46)	0.027
Profitability	0.007*** (15.27)	0.000
Market valuation	0.025* (1.83)	0.014
Term spread	-4.933** (–2.84)	1.735
Labour intensity	0.025*** (6.07)	0.004
Patent	0.037*** (6.62)	0.009
Add-on	-0.136*** (–3.94)	0.034
Hitech	-0.15** (–1.96)	0.076
Market price impact	-16.680*** (–5.06)	3.300
Add-on	-0.054** (–2.57)	0.021
Control	-0.145*** (–2.32)	0.062
Value factor	-0.008** (–2.73)	0.003
Inverse leverage PC	-0.011** (–1.94)	0.010
Industry valuation PC	0.050*** (4.60)	0.011
PECCS® indicators	*Included*	
Variance inflation factor	1.365	
Observations	5,438	
Adjusted R^2	0.263	

***/**/* denotes statistical significance with p-value < 0.01, <0.05, and <0.1, respectively.

Model diagnostics confirmed that the residuals (the differences between observed and predicted valuations) were normally distributed, and the model's predictions closely matched actual valuations, with errors near zero. Importantly, the model performed consistently well when tested on new data outside the sample. These results are shown in table 5 and figure 3.

However, the relationship between valuation and factors like growth, market valuation and industry effects need not be stable over time. In some periods, these factors even reversed their typical influence, highlighting the need for models that can accommodate such dynamics. For example, a simple correlation between valuation and these factors flip sign when examined on a subsample period of transactions, thus providing motivation for estimating time-varying betas.

DLMs

To address these changing relationships, we use DLMs, which allow factor effects on valuation to evolve over time. The coefficients in the model update with each new transaction, capturing how investor preferences shift and how market conditions influence valuations differently across periods.

For the sake of brevity, we present the descriptive statistics of factor prices for key variables estimated from the dynamic linear model in table 6. To show the effect of variation we also plot the factor price for size in our sample period as an illustration in figure 4. Both show that factor prices vary through time considerably, further validating the use of a dynamic estimation to better capture investor preferences.

The DLM model diagnostics confirm those seen with the final OLS errors (table 7). Moreover, examining the prediction error by various segments confirm that the average errors, even in the untransformed P/S scale are considerably smaller (always less than ±6%), thus confirming the view that the predicted valuations provide a good understanding of the overall market and that of its key segments.

Figure 5 presents the trends in the 12-month moving average of the predicted valuations from the DLM estimates.

It indicates:

- First, the 12-month moving average of the model predicted P/S is de-smoothed and exhibits comparable levels of volatility with public equity benchmarks.
- Second, the predicted P/S time series is highly correlated with public equity benchmarks.
- Third, the predicted P/S is remarkably similar to the 12-month moving average of raw transaction valuations, alleviating the concern that the model introduces any unnatural variation.

Conclusion

Private equity has experienced tremendous growth, yet its holdings remain largely opaque because these assets are

Table 5. Final OLS model errors

Sample	Mean log P/S	Mean error	Median error	Mean abs. error	Median abs. error	Mean sq. error
In-sample	0.5802	0.0000	-0.0050	0.6410	0.5434	0.6402
Out-of-sample	0.5873	-0.0341	-0.0650	0.6258	0.5210	0.6020

Figure 3. Residuals of final OLS model

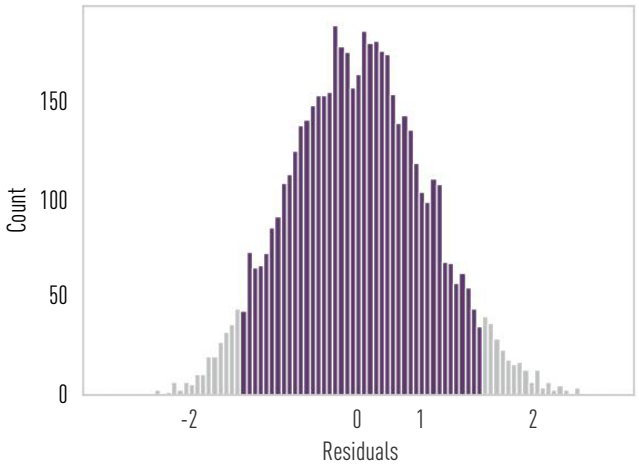


Table 6. Descriptive statistics of factor prices (or model coefficients) from DLM

Variable	Mean	Median	Min	Max	Std dev
Size	-0.0623	-0.0648	-0.1048	-0.0091	0.0231
Growth	-0.0076	-0.0074	-0.0161	0.0024	0.0047
Profitability	0.0097	0.0096	0.0048	0.0291	0.0056
Market valuation	0.0576	0.0568	0.0454	0.1025	0.0125
Term spread	0.0128	0.0131	0.0099	0.0154	0.0023

Figure 4. Size factor price evolution in DLM

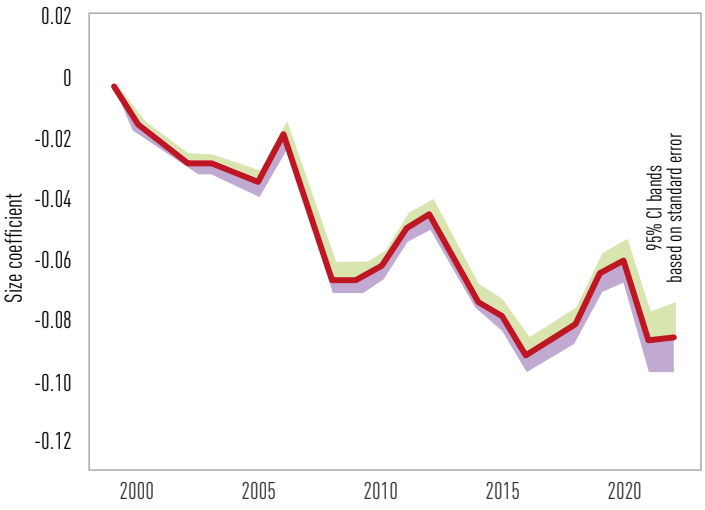
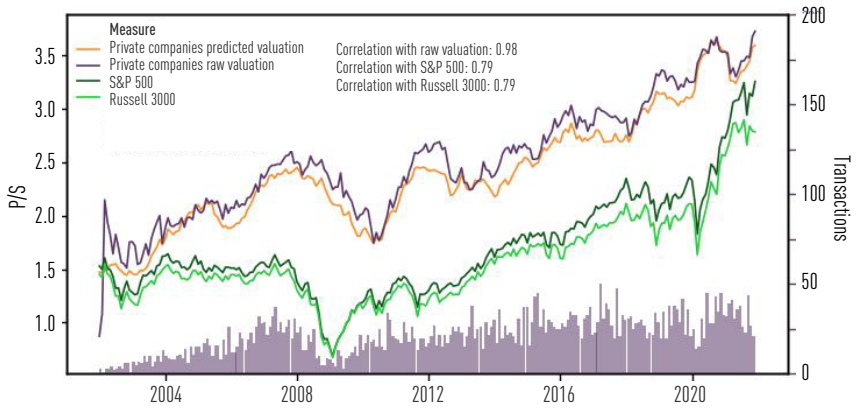


Table 7. DLM in-sample errors

Sample	Mean log P/S	Mean error	Median error	Mean abs. error	Mean error in P/S
Full sample	0.5900	0.0006	-0.0043	0.5881	1.10%
Activity Education & public	0.7955	-0.0032	-0.0181	0.5627	-0.48%
Activity Financials	0.6973	0.0044	-0.0145	0.5718	1.82%
Activity Health	0.8165	-0.0033	-0.0106	0.5516	-1.14%
Activity Hospitality & entertainment	0.6889	0.0028	0.0004	0.5383	-1.40%
Activity Information & communication	0.7230	-0.0032	-0.0101	0.5897	-1.96%
Activity Manufacturing	0.4240	-0.0126	-0.0102	0.5686	-2.47%
Activity Natural resources	0.9303	0.0201	0.0154	0.6057	3.28%
Activity Professional & other services	0.6755	-0.0083	-0.0062	0.6017	3.39%
Activity Real estate & construction	0.4705	-0.0002	-0.0045	0.6070	-0.09%
Activity Retail	0.4046	-0.0027	-0.0068	0.5751	-3.51%
Activity Transportation	0.5112	0.0022	-0.0087	0.5687	-0.66%
Activity Utilities	0.6287	-0.0046	-0.0122	0.5777	-1.81%
Lifecycle Mature	0.5050	-0.0024	-0.0089	0.5780	-1.60%
Lifecycle Growth	0.5444	-0.0010	-0.0084	0.5783	-0.31%
Lifecycle Startup	0.7366	0.0027	-0.0034	0.5872	1.32%
Revenue model Production	0.7152	0.0020	-0.0052	0.5942	1.22%
Revenue model Avertising	0.5674	-0.0024	-0.0067	0.5798	-0.92%
Revenue model Subscription	0.8009	0.0037	-0.0044	0.5874	1.22%
Revenue model Reselling	0.5805	0.0036	-0.0057	0.5898	1.46%
Custome model B2C	0.6254	0.0026	-0.0048	0.5970	1.03%
Customer model B2B	0.5483	-0.0046	-0.0068	0.5785	-1.67%
Value chain Products	0.6457	0.0033	-0.0023	0.5916	1.03%
Value chain Services	0.6815	0.0058	-0.0033	0.5845	0.69%
Value chain Hybrid	0.4689	-0.0159	-0.0126	0.5783	-5.59%

Figure 5. Trends in model predicted, raw and public market valuations



not frequently traded. Investors are increasingly reluctant to depend on smoothed, appraised valuations that can mask true value changes. Although transaction data offers valuable insights, it is often biased due to deal clustering. Current benchmarks based on GP reported valuations suffer from biases such as smoothing, reporting delays and incompleteness. Addressing these issues is critical, especially as accounting standards emphasise fair value and private investments become more accessible to a broader range of investors, including pension funds.

Our paper proposes a factor model approach that leverages private equity transaction data to overcome traditional challenges like data staleness, sparseness and bias, while avoiding dependence on GP-estimated valuations. Central to the approach is the innovative PECCS® classification system, which groups private companies across multiple dimensions – including industry, lifecycle stage, revenue model, customer type and value chain – to capture key risk factors despite limited data availability. Calibrated with a large, global and representative transaction dataset, our model reveals how company-specific traits, market conditions and transaction characteristics drive private company valuations. The chosen factors draw on academic research, private market realities and surveys of fund managers. Importantly, the model incorporates dynamic estimation to allow factor prices to evolve over time, reflecting changing investor preferences.

Key factors affecting valuation include profitability, leverage, labour intensity, technology and company age. Transaction details such as deal leverage, whether the deal is an add-on and the ownership stake sought also matter. Market and industry valuations, stock market liquidity and interest rate spreads influence valuations as well, with many effects shifting over time. PECCS® classification groups have significant time-varying impacts, highlighting the value of a multi-dimensional taxonomy for private company analysis.

The model's broad applications include:

- ***Private company indices:*** By applying the factor model to extensive financial data across many private companies, it can estimate values for non-traded assets, enabling the creation of detailed indices at global, country and PECCS® classification levels. The PECCS® taxonomy provides a solid structure for summarising private market performance and identifying opportunities.
- ***High-frequency updates:*** Since many market inputs are available monthly, these indices and benchmarks can be updated frequently. This capability allows for capturing changes from staggered fiscal years and produces relevant, representative benchmarks for limited partners (LPs), GPs and other stakeholders.
- ***Custom valuations:*** The standardised model reduces biases and offers a high-frequency framework for valuing private company portfolios. Aggregating valuations at the portfolio level can improve accuracy by offsetting individual asset errors, thereby delivering more reliable return and risk metrics that benefit both LPs and large GPs.

Overall, our factor model strikes a balance between granularity and robustness, providing highly detailed and

accurate segment-level valuation metrics. Calibrated on a large transaction dataset and applicable to a broad universe of non-traded private companies, this approach supports more timely mark-to-market valuations, overcomes common valuation biases, clarifies diversification benefits and ultimately enables better-informed portfolio allocation and monitoring for investors.

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Market risk in private equities: the prominent role of systemic risk factors

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Systematic risk Is measurable and priced: **The study shows that private equity asset prices are significantly influenced by systematic risk factors such as size, leverage, profitability, growth and maturity, as well as PECCS®-defined market segments.**

Volatility and insolvency risks are segment-dependent: **Operating performance volatility and insolvency risk vary systematically across systematic risk factors and PECCS® segments, with early-stage, small and highly leveraged firms showing the highest risk.**

Transaction prices reflect risk exposure: **Valuation multiples and implied discount rates from over 5,000 private equity transactions reveal consistent pricing patterns aligned with risk exposures, confirming that investors systematically price these risks.**

Bid-ask spreads: **When uncertainty is expressed in the predictions from a multi-factor model based on limits to discount rate volatility, up to 67% of transaction price variability can be accounted for. This indicates that idiosyncratic risks in valuation remain the minority. Thus, accounting for systematic risk factors enables more accurate benchmarking and valuation of private equity portfolios.**

Introduction

This article explores the role of systematic risk factors in explaining the pricing of private equities. The study analyses firm-level operating performance volatility across a large asset level database and evaluates this volatility against key risk factors and market segments. We then evaluate extreme risk by reviewing insolvency risk across the same risk factors and market segments. Finally, our paper evaluates a large database of completed private equities transactions to assess whether pricing reveals discrimination by risk factors and market segments, and measures the extent to which observed price variation can be accounted for.

The term 'private equities' is used to specifically denote the market for investing directly in the equity stakes of private companies. This is different from 'private equity', which typically refers to investing in private equity funds. Investors in private equity funds are exposed to three risks:

- ***Liquidity risk:*** Investments are typically illiquid, with capital locked up for extended periods (often 10-12 years), limiting the ability to easily liquidate positions.
- ***Cash flow risk:*** Cash inflows and outflows associated with private equity funds are unpredictable and challenging to forecast accurately.
- ***Market risk:*** Fluctuations in overall market conditions directly influence investment valuations and exit opportunities.

Among these, market risk remains the least understood and least documented risk in current academic literature, which often conflates market risk with liquidity and cash flow risks by focusing predominantly on fund-level data for analysis. Our paper focuses on market risk, as it is the central rationale behind investing in private equities. The objective of the investor is to gain exposure to the private equities beta or market risk premium. Enhanced comprehension of market risk lays the foundation for understanding systematic risk in private equities, leading to better valuation of private equities and implications for benchmarking the performance of private equities assets and portfolios.

Our paper finds that a significant share of the pricing dynamics of private equities' transactions (~67%) is explainable with the combination of systematic risk factors and the bid-ask spread (part III).

Literature review

Current financial literature on private equity funds primarily focuses on documenting risk-adjusted returns and proposing methodologies for managing liquidity and cash flow risks. However, these studies frequently rely on 'stale' or 'smoothed' net asset values provided by general partners, significantly hindering precise measurement of market risk at both fund and asset levels. While methodologies such as the liquidity-adjusted value-at-risk and cash flow-at-risk proposed by Jorion (2024) effectively address liquidity and cash flow uncertainties, market risk remains obscured due to the opaque and self-reported nature of private equity valuations.

Much existing research tends to

conflate market, liquidity and cash flow risks, predominantly focusing at the fund level. Notable studies, including Groh and Gottschalg (2005) and Markarian and Breuer (2023), emphasise significant risks in private equity due to extended investment horizons, restricted liquidity, and low transparency. Research by Gupta and Nieuwerburgh (2021) and Jegadeesh et al (2015) highlights systematic risks inherent to private equity, while Gottschalg et al (2004) document higher risk levels (beta) in private equity compared to public equities when considering leverage and holding durations. Additionally, the 'stale price' phenomenon, characterised by infrequent valuation updates, understates volatility and complicates comparisons with public market returns.

Consequently, existing literature has yet to adequately address asset-level market risk. This gap makes it difficult to differentiate whether identified risks originate from inherent market volatility in private equities or from the structural elements of private equity funds themselves.

Data

Our study utilises three primary datasets to comprehensively assess risks and valuations within the private equities market:

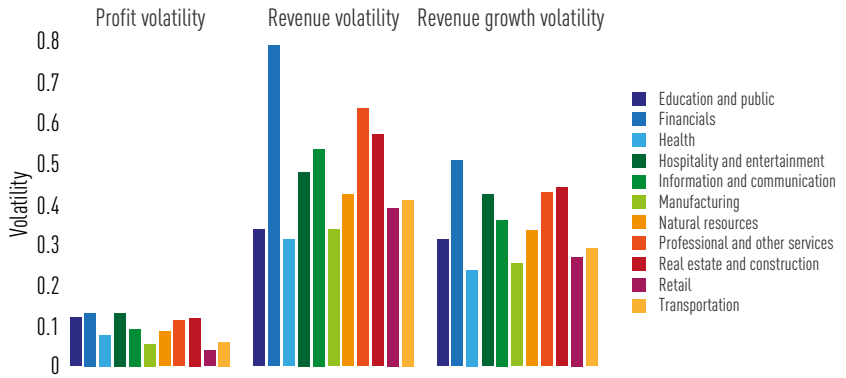
- ***Asset-level financials dataset:*** This dataset comprises detailed financial data from firms across more than 150 countries, spanning the years 2013 to 2024. Table 1 details the key descriptive statistics of the database as of 31 December 2023.
- ***Transaction-level private equity entry/exit price dataset:*** Sourced from Pitchbook and Capital IQ, this dataset originally included more than 10,000 transactions recorded between 2005 and 2024. After accounting for missing data, over 5,000 validated transactions remain. These transaction records offer valuable insights into typical pricing patterns across different activity pillars as defined by the Private Equity Common Classification Standard (PECCS®), thus enabling nuanced analyses of pricing dynamics (PECCS [2023]).
- ***privateMetrics® monthly priced universes:*** This extensive database encompasses monthly valuations for over 1m private companies from more than 100 countries over a 10-year period. It integrates audited financial statements, commercial data sources and AI-driven document analysis. Companies within this dataset are systematically classified according to PECCS®, covering dimensions such as activity, lifecycle, revenue model, customer model and value chain. The database features the private2000® index, which tracks 2,000 private companies from 30 countries, with monthly pricing benchmarks for the private asset class. Furthermore, the database differentiates between the broad private market universe (BMU) and the more focused private equity backed universe (PEU). The PEU specifically controls for firm size, profitability and sector alignment, mirroring characteristics typical of companies involved in private equity transactions. As of 31 December 2024, the PEU consists of approximately 193,000 entities with a collective market capitalisation of $19trn and a median revenue of $19.8m.

Table 1. Financial database
Key statistics for year ending 31 December 2023

Universe profile ($m)	Global	Advanced	EU
Companies	824k	637k	171k
Revenue	10.3/53.2	10.6/48.9	14.3/83.8
Ebitda	0.71/5.29	0.79/5.13	0.98/8.3
Ebit	0.58/4.1	0.64/3.77	0.64/5.29
Net income	0.42/3.02	0.47/2.81	0.46/4.1
Revenue growth	2.5%/5.8%	2.2%/4.9%	2.7%/6.8%

Presented as median/mean

Figure 1. Operating performance volatility by industrial activity



Source: privateMetrics. Based on 1m firms as of 2023 with a minimum of five years of data.

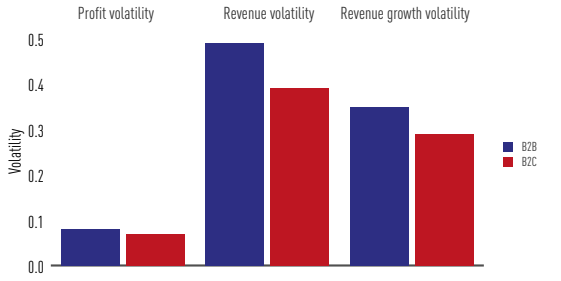
I: Economic risk factors in private equities

This section analyses firm-level risk within private equities, focusing primarily on operating performance volatility and insolvency risk, and how both are impacted by exposure to key risk factors and market segments (PECCS®). It highlights that there are clear 'risk buckets', with certain risk factors and market segments linked to elevated operating performance volatility and insolvency risk. In short, varying levels of firm-level operating performance volatility and insolvency risk can be partly explained by systematic risk factors and the firms PECCS® orientation.

Operating performance volatility is assessed by analysing revenue, profit and revenue growth fluctuations. Systematic differences emerge clearly across various segments of PECCS®. For instance, early-stage companies display significantly higher volatility across all metrics compared to mature firms. Similarly, subscription-based revenue models exhibit greater volatility compared to markup (or reselling) models, and companies in the services segment face more substantial volatility than product-focused firms.

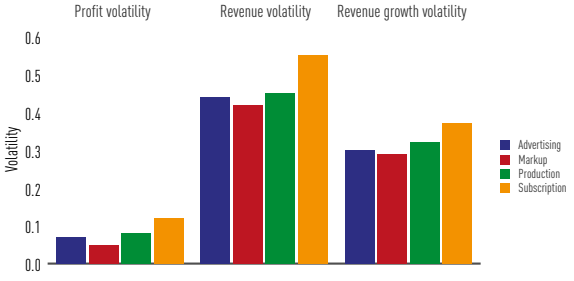
Sectoral analysis (figure 1) indicates pronounced differences, with sectors such as financials, professional and other services, and real estate and construction experiencing notably higher revenue volatility compared to health and manufacturing sectors. Customer models also influence volatility significantly, with business-to-business (B2B) firms experiencing higher financial performance fluctuations compared to business-to-consumer (B2C) counterparts (figure 2). The subscription revenue model consistently demonstrates the highest volatility across revenue, growth and profit metrics, whereas the markup

Figure 2. Operating performance volatility by customer model



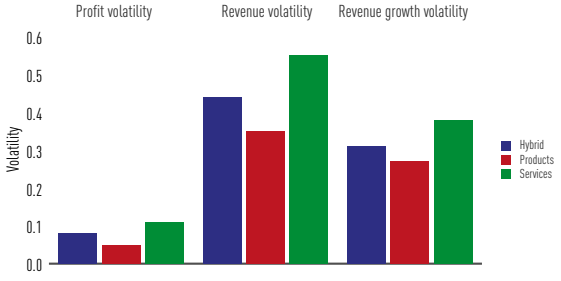
Source: privateMetrics. Based on 1m firms as of 2023 with a minimum of five years of data.

Figure 3. Operating performance volatility by revenue model



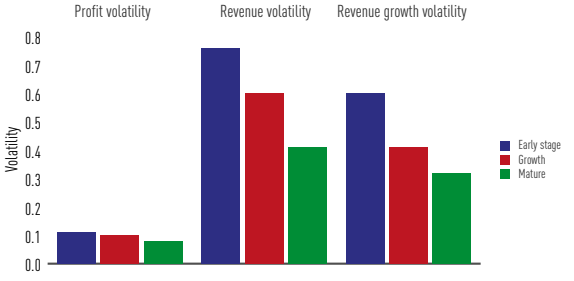
Source: privateMetrics. Based on 1m firms as of 2023 with a minimum of five years of data.

Figure 4. Operating performance volatility by value chain



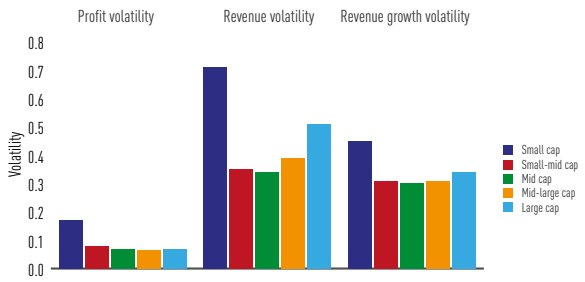
Source: privateMetrics. Based on 1m firms as of 2023 with a minimum of five years of data.

Figure 5. Operating performance volatility by lifecycle



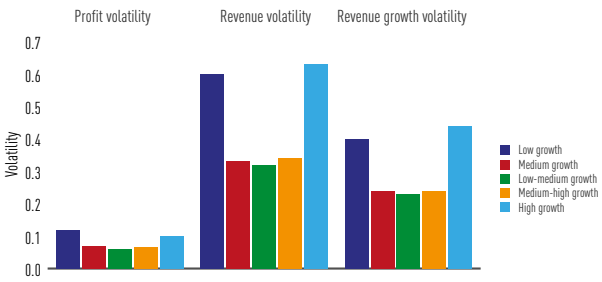
Source: privateMetrics. Based on 1m firms as of 2023 with a minimum of five years of data.

Figure 6. Operating performance volatility by risk factors: size



Source: privateMetrics.

Figure 7. Operating performance volatility by risk factors: growth

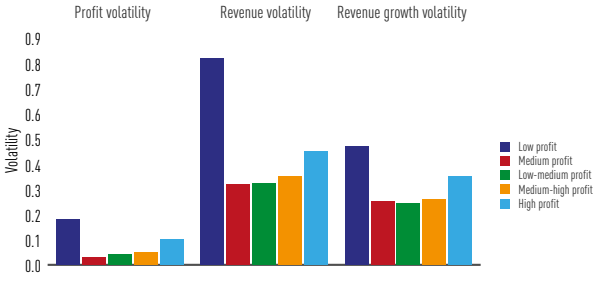


Source: privateMetrics.

model presents the lowest volatility (figure 3). Moreover, firms within the services value chain show notably higher volatility than those producing goods or hybrid models (figure 4). Lifecycle analysis further underscores these differences, with early-stage companies exhibiting dramatically elevated volatility, followed by growth-stage and mature companies (figure 5).

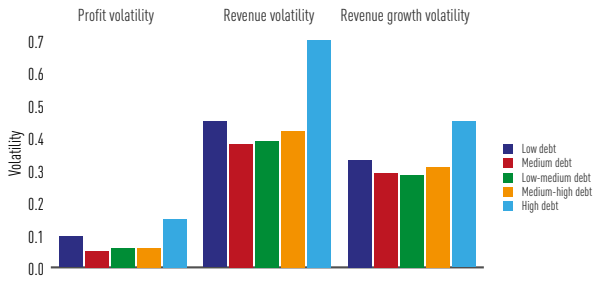
Detailed analysis across various risk factors underscores additional systematic volatility patterns. Smaller companies, particularly small-cap firms, consistently show heightened volatility across revenue, growth and profit metrics (figure 6). A distinctive U-shaped volatility pattern emerges concerning growth rates, with the highest volatility recorded among low and high-growth firms, though low-growth firms dominate this category (figure 7). Companies with low profitability similarly experience markedly higher volatility compared to more profitable segments (figure 8). Higher leverage also correlates

Figure 8. Operating performance volatility by risk factors: profit



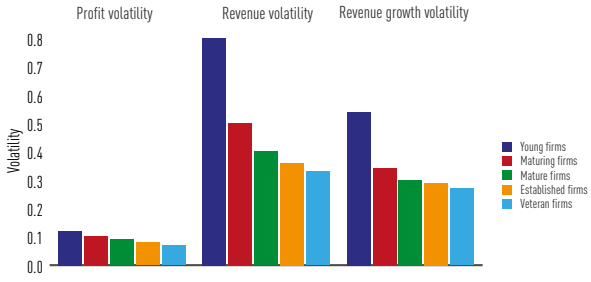
Source: privateMetrics.

Figure 9. Operating performance volatility by risk factors: leverage



Source: privateMetrics.

Figure 10. Operating performance volatility by risk factors: maturity



Source: privateMetrics.

directly with increased operational volatility (figure 9), while younger firms demonstrate dramatically higher revenue volatility relative to mature firms, indicating an inverse relationship between maturity and volatility (figure 10).

Regression analyses further validate these relationships, affirming that smaller, highly leveraged and younger companies experience higher operating performance volatility at statistically significant levels. Comparative analysis between private and listed equities reveals that operating performance volatility is broadly similar across sectors in both markets (table 2). Additionally, correlations between public and private markets are positive and strong across sectors, with the exception of energy.

Insolvency risk, defined as the first occurrence when total assets fall below total liabilities, presents notable variations influenced by key risk factors (figure 11). The smallest firms experience the highest insolvency prevalence (33%), while insolvency likelihood escalates substantially with increasing leverage. Low-profit companies contribute significantly (74%) to insolvency events, and a U-shaped insolvency pattern emerges with growth rates, highlighting the highest incidence in low-growth firms, followed by high-growth entities. Younger firms are particularly susceptible to insolvency, underscoring a negative correlation between firm age and insolvency risk.

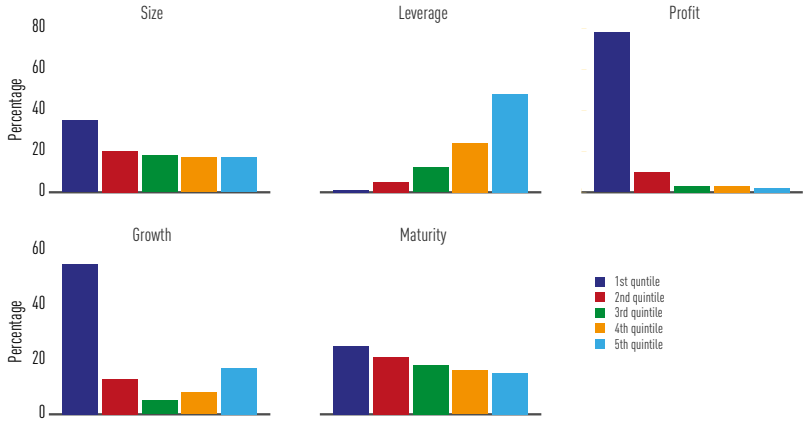
Cumulative insolvency rates vary across PECCS® segments, ranging from lower rates in utilities (approximately 10%) to higher rates in natural resources (around 20%). Early-stage firms face substantially higher cumulative insolvency risks compared to mature firms. Operating performance volatility correlates strongly with cumulative insolvency risks across various PECCS® categories.

Table 2. Comparison of operating performance risk in listed equity and private equities (%)

GICS sector	Profit volatility (listed)	Revenue volatility (listed)	Growth volatility (listed)	PECCS® equivalent	Profit volatility (private)	Revenue volatility (private)	Growth volatility (private)
Consumer discretionary	2.9	20.7	11.1	Hospitality	10.3	36.2	30.2
Staples	2.0	17.7	10.3	Retail	3.5	32.5	22.5
Energy	8.3	34.0	28.2	Natural resources	8.6	41.8	31.0
Financials	5.5	21.5	11.4	Financials	11.6	62.6	40.7
Health care	3.0	35.0	26.8	Health	6.9	24.7	18.6
Industrials	2.2	20.9	12.3	Manufacturing	6.3	32.8	23.4
Information technology	5.2	25.8	14.2	Information & communication	7.9	42.0	30.2
Real estate	0.2	30.2	14.2	Real estate & construction	10.9	49.6	39.0
Utilities	3.7	13.8	11.1	Utilities	7.5	41.6	22.7

Source: privateMetrics, Compustat.

Figure 11. Insolvency event incidence by risk factor beta



Source: privateMetrics.

Regression results confirm these insights at significance, with profitability, revenue growth, leverage and firm age as significant and robust predictors of insolvency risk.

Overall, operating performance volatility and insolvency risk exhibit systematic and significant differences across PECCS® segments and key risk factor exposures, providing a basis for valuing private equity firms with a multi factor model that incorporates key risk factors and a firm's orientation within the PECCS® taxonomy.

II: Systematic risk factors and private market prices

This section examines whether the systematic risks previously identified in private equities are reflected in observable transaction data, exploring whether these risks can explain variations in market pricing.

Transaction prices demonstrate systematic variations by PECCS®. As shown in table 3, clear differences emerge in valuation multiples such as price-to-sales (P/S) and price-to-Ebitda (P/Ebitda) across PECCS® classifications. Specifically, sectors like information and communication and health command the highest P/Ebitda multiples, whereas natural resources exhibits the lowest. Additionally, transaction multiples significantly differ by lifecycle stages, with startup and growth-stage firms obtaining notably higher valuations compared to mature companies. Subscription-based revenue models similarly attract higher valuations compared to firms using reselling or production-based models.

Analysing systematic risk factors further illuminates transaction pricing variations. Smaller firms typically transact at higher multiples, suggesting that investors require higher risk premiums for larger firms. High-growth companies consistently attract elevated valuations, reflecting a direct relationship between growth potential and valuation multiples. Profitability also emerges as a critical determinant, with more profitable firms achieving higher transaction prices. Conversely, younger companies generally receive higher valuations, highlighting an inverse relationship between firm maturity and valuation. Additionally, higher leverage is associated with higher valuation multiples, likely signalling superior firm quality and debt capacity. Country risk, defined by term spread differentials, significantly influences valuations, with higher risk countries commanding lower multiples due to elevated required premiums.

Implied discount rates derived from transaction data using a modified Gordon model indicate significant differences across key risk factors and PECCS® segments. Systematic variations in implied discount rates across PECCS® pillars reveal that sectors such as utilities, retail, hospitality and entertainment, and transportation had lower implied discount rates. Conversely, sectors like real estate and education exhibit some of the highest discount rates. Early-stage companies consistently show elevated discount rates compared to mature firms, reflecting higher perceived risks. Similarly, firms in the services value chain and those operating B2B models present higher discount rates relative to product-focused and B2C companies, respectively. Revenue models also significantly influence discount rates, with advertising-based revenue models exhibiting notably higher rates compared to markup (reselling), production or subscription models.

Regression analysis validates these observations, indicating that implied discount rates, cash yield, and profitability significantly and systematically explain transaction prices. These factors are statistically robust determinants of the P/S ratio, demonstrating correct signs and low multicollinearity.

In summary, observable transaction data confirm systematic differences across various PECCS® pillars and key risk factors. Transaction multiples and implied discount rates consistently reflect these systematic variations, with factors such as profitability, company size and revenue growth playing critical roles in determining valuations.

Table 3. P/S and P/Ebitda multiples by PECCS® segment. 2013–24

PECCS® activity	P/S	P/Ebitda
Education & public	1.9x	12.4x
Financials	2.4x***	11.1x***
Health	2.1x	13.1x***
Hospitality & entertainment	1.9x	11.5x**
Info comm	2.6x***	12.8x***
Manufacturing	1.5x***	10.1x
Natural resources	1.9x	7.4x**
Professional services	1.6x**	10.3x
Real estate & construction	1.8x	10.5x
Retail	0.9x***	10.3x
Transportation	1.4x***	8.8x**
Utilities	1.9x	10.2x
All transactions	1.7x	10.9x
Lifecycle phase	**P/S**	**P/Ebitda**
Early-stage	2.4x***	12.1x
Growth	2.1x	12x***
Mature	1.6x***	10.5x***
Revenue model	**P/S**	**P/Ebitda**
Advertising	2.1x***	10.9x
Markup	1.4x***	10x
Production	1.6x***	10.5x
Subscription	2.9x***	13.6x***
Value chain	**P/S**	**P/Ebitda**
Hybrid	2.4x	10.9x
Products	1.5x***	10.5x***
Services	1.9x	11.3x***
Customer model	**P/S**	**P/Ebitda**
B2B	1.8x	10.6x***
B2C	1.7x***	11.4x***

Source: Pitchbook, CapitalIQ, based on >5k transactions from 2013 to 2024. Calculations by EIPA.
*** 1% confidence interval/** 5% confidence interval

III: Systematic versus idiosyncratic risk in private equity

In this section, we quantify how much of private asset transaction pricing can be attributed to systematic factors versus idiosyncratic elements. We employ a straightforward factor model based on an ordinary least squares (OLS) regression, to explain variations in private asset prices. We incorporate common risk factors – size, leverage, age, term spread, growth and profit – as well as controls from PECCS®, including industrial activity, revenue model, lifecycle phase, customer model and value chain, alongside region and time dummy variables. This model emphasises parsimony while capturing key explanatory variables.

A significant challenge with standard OLS predictions is their wide residuals, which yield impractical confidence intervals. To address this, our study sets out to specify an uncertainty in the predicted estimate, by shifting the focus to valuation sensitivity arising from discount rate volatility. Building on the concept of 'good-deal bounds' from Cochrane and Saa-Requejo (2000), discount rate volatility is framed relative to the Sharpe ratio of the S&P 500, allowing the calculation of practically meaningful upper and lower discount rate bounds (±1.96 standard deviations for 95% confidence). These bounds on discount rate volatility can translate into bid and ask prices around predicted valuations. To mitigate look-ahead bias, average monthly discount rates per activity are estimated from private2000® index constituents, providing robust, forward-looking estimates.

Analysing 3,928 transactions spanning 2013–24, the OLS regression reveals significant patterns (see table 4). Larger and older companies tend to have lower valuations, while higher leverage and profitability positively influence valuations. Overall, this model explains approximately 30% of the observed price variation (R^2: 0.2973) and demonstrates low multicollinearity (VIF of 3.33). Diagnostic evaluation shows a mean error near zero but a relatively high mean absolute error (MAE) of 0.79 on a log scale, indicating substantial prediction uncertainty at the individual transaction level. However, residuals are

normally distributed, confirmed by a Kolmogorov-Smirnov test (p-value 0.30). Additionally, figure 12 illustrates a high correlation (0.92) between rolling medians of observed and predicted valuations, indicating the model's effectiveness in capturing overall trends.

Discount rate estimation shows plausible sector-specific averages ranging from 7–17% within the private2000 index (see table 5), with transaction-specific mean and median discount rates at 14% (see figure 13). A comparison with public market discount rates, illustrated in figure 12, highlights that private market discount rates are consistently higher and vary significantly over time, challenging traditional fixed illiquidity premium assumptions. The correlation of private market and S&P 500 expected returns is notably high (0.83), indicating synchronised market dynamics.

Using these average discount rates from private2000, the bounds in discount rate volatility assuming private markets offer thrice the Sharpe ratio of S&P 500, and as assumed investment horizon of approximately 6.7 years (based on McKinsey's 2025 Global Private Markets report), we quantify the bid-ask valuation spread, finding an average half-spread of 1.18x, with a median of 0.47x. Notably, 67.67% of the observed valuations fall within these bid-ask bounds, suggesting the practical utility of the predicted valuations and associated uncertainty bands. For the remaining 32.33% of observations outside these bounds, residual distributions remain approximately Gaussian. Critically, when employing these dynamic bid-ask bounds, the unexplained MAE substantially decreases to around 0.39 in log scale – a 65% reduction compared to standard OLS predictions – and the adjusted R-squared based on these bounds reaches 0.67. This underscores that combining the model with clearly defined uncertainty bands provides a more accurate and comprehensive explanation of private asset pricing dynamics.

Table 4. An OLS factor model of transaction valuation, 2013–24

Coefficients	Estimate	Standard error	t value	Pr(>|t|)
Dependent variable: P/S				
Size	-0.234***	0.012	(-20.18)	0.00
Leverage	0.085***	0.008	(11.21)	0.00
Age	-0.145***	0.025	(-5.73)	0.00
Term spread	-1.184	4.897	(-0.24)	0.81
Growth	0.031	0.030	(1.03)	0.30
Profit	0.781***	0.070	(11.08)	0.00
Intercept	3.523	3.459	(1.02)	0.31
Fixed effects				
PECCS® classes	Yes			
Calendar quarter	Yes			
Regions	Yes			
Fit statistics				
Observations	3,928			
Significance codes: 0 *** 0.001 ** 0.01 * 0.05.				
Residual standard error: 1.0122 on 3,849 degrees of freedom				
R-squared: 0.2973, Adjusted R-squared: 0.2830, Variance inflation factor: 3.33				
F-statistic: 20.88 on 78 and 3,849 DF, p-value: 0.00				

Source: PitchBook and Capital IQ. Calculations by EIPA. All variables except profit are log-transformed.

Figure 12. Average time trends based on OLS factor model predictions

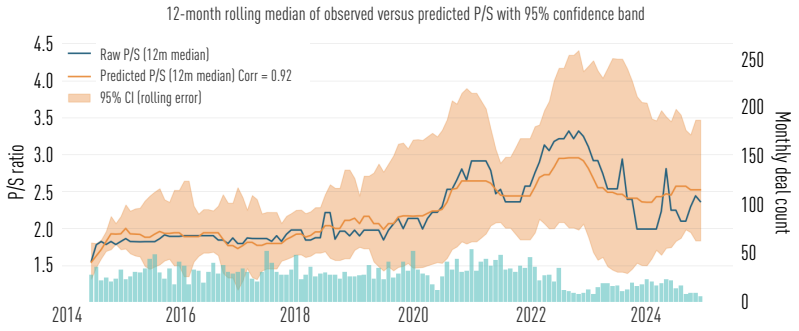


Table 5. Descriptive statistics of private2000 discount rates by PECCS® activity, 2013–24 (N=141)

Activity	Mean	Standard deviation	Min	25th percentile	Median	75th percentile	Max
Education and public	0.16	0.03	0.08	0.14	0.15	0.17	0.24
Health	0.07	0.02	0.05	0.06	0.07	0.08	0.11
Hospitality and entertainment	0.13	0.03	0.07	0.10	0.12	0.15	0.21
Information and communication	0.14	0.03	0.08	0.12	0.15	0.16	0.18
Manufacturing	0.17	0.03	0.10	0.14	0.16	0.19	0.23
Natural resources	0.14	0.06	0.03	0.09	0.13	0.18	0.23
Professional and admin services	0.13	0.03	0.07	0.12	0.13	0.16	0.18
Real estate and construction	0.18	0.04	0.07	0.16	0.18	0.21	0.29

Source: Pitchbook and Capital IQ. Discount rates calculated by EIPA.

Conclusion

Systematic risk in private assets

Parts I and II establish that private assets are exposed to common risk and segment factors, and that their transaction prices vary systematically across these dimensions. Part III quantifies how much of these prices can be explained by such systematic factors. We also examine the role of bid-ask spread in residual price uncertainty, helping to distinguish between systematic and idiosyncratic components of price variation. While some idiosyncratic risk remains, we demonstrate that having accounted for systematic influences, what remains is white noise.

Implications for asset pricing

Our findings challenge the view that private equity risk is unobservable. Using detailed private company financial data and transaction-level data, we show that:

- Systematic risks are measurable across firm-level factors (eg, size, growth, profitability, leverage, maturity) and market segments defined by the PECCS® classification. These risks influence volatility and default probability.

Figure 13. Estimated discount rates for transactions, 2013–24

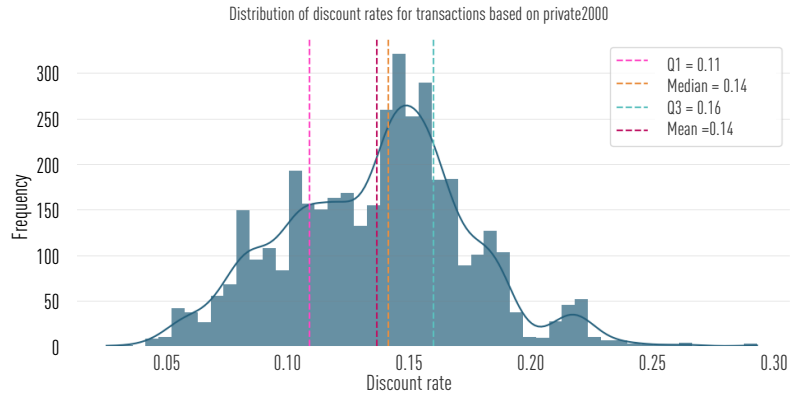
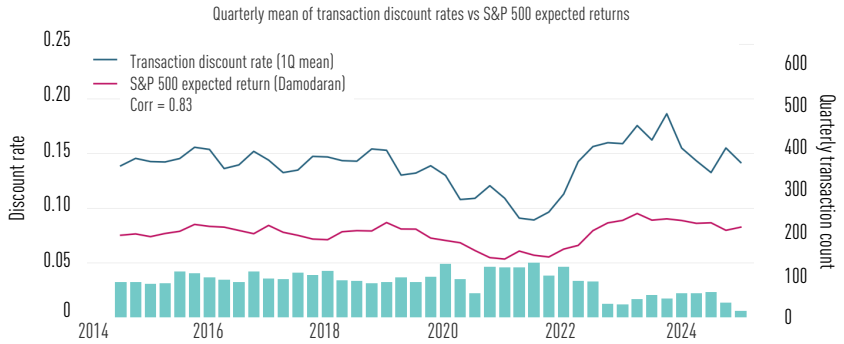


Figure 14. Time trends in estimated discount rates for transactions and public markets, 2013–24



● Investors price these risks systematically. Transaction multiples and expected returns align with risk exposures and PECCS® classifications, similar to pricing behaviour in public markets.

● Systematic factors explain a substantial share of price variance, suggesting that private equity markets, though less liquid, follow coherent pricing dynamics.

These findings have significant implications for valuation. Traditional methods like DCF rely on the CAPM, which uses a public market proxy that fails to reflect private market dynamics. Likewise, valuation using comparables – especially from public firms – ignores key risk differences and market characteristics. Both approaches are inadequate without adjusting for systematic risk exposures.

Implications for benchmarking

Identifying and pricing systematic risk at the asset level enables more accurate benchmarking of private equity funds. This approach separates market risk from liquidity and cash flow risk – something traditional fund-level methods conflate.

Current benchmarks, whether public market proxies or manager-defined, fail to capture true market risk in private assets. Public market indices do not reflect private equity exposures, and manager-derived benchmarks reflect idiosyncratic portfolio choices, not broad market conditions.

Instead, benchmarks should be based on a factor model that prices private assets using systematic risk factors. This allows LPs to assess whether GPs are adding value beyond what is explained by the private equity market itself – across sectors, life cycle stages, revenue and customer models, and value chain positions.

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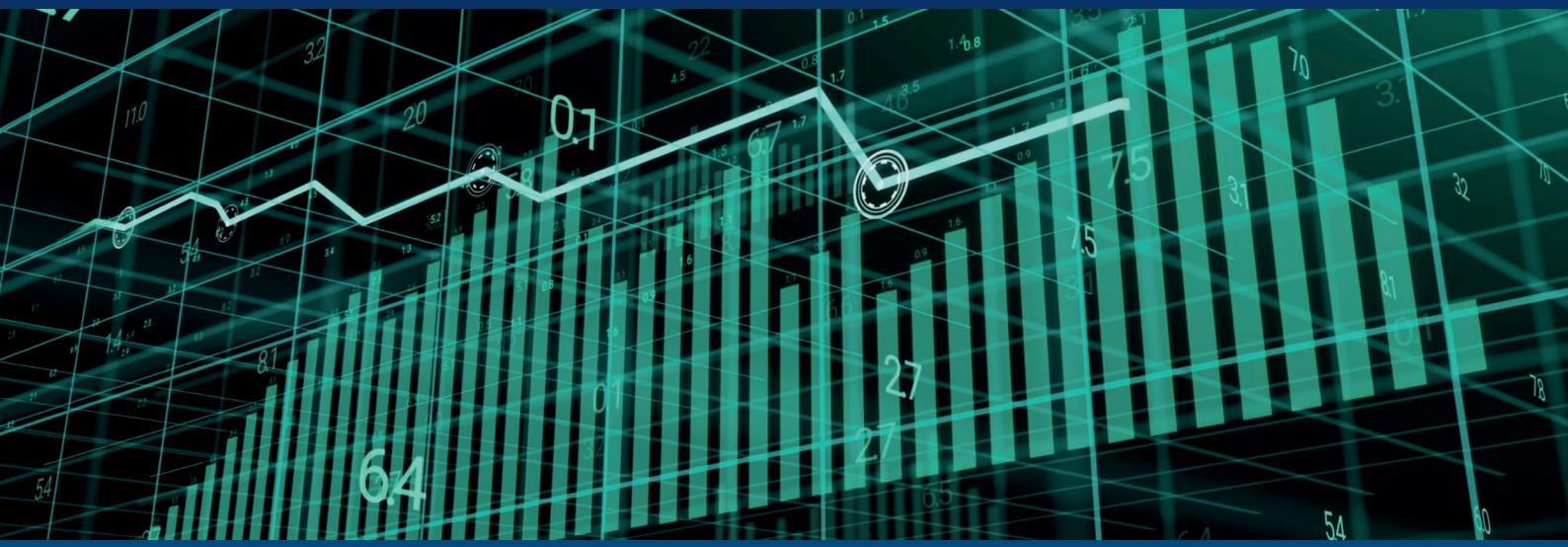

EDHEC Infrastructure and Private Assets Day 2025 will be held on 9 December, 2025 in London, where leading academics and industry experts will convene to share the latest research and insights on unlisted assets.

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Does size matter?

A closer look at alpha across fund size

Evan Clark, Senior Private Market Analyst, EDHEC Infrastructure & Private Assets Research Institute

Small and mega funds outperform: **We analysed 586 US-focused buyout funds (2013–23) and our investigations revealed that small (<$500m) and mega (>$5bn) funds generated positive alpha, while mid-sized funds underperformed. Small funds had the highest median alpha (+5.6%), and mega funds also delivered consistent, though lower, positive alpha.**

Dispersion and risk vary by size: **Smaller funds show greater dispersion in returns – both high outperformance and severe underperformance – indicating higher risk. Mega funds exhibit tighter return distributions, suggesting lower risk and more stable outcomes.**

Manager incentives drive scaling: **The private equity fee model incentivises managers to raise larger funds over time, leading successful managers to migrate into the mega-cap space. This may explain why top-performing managers are concentrated in the largest fund segment.**

Systematic risk and strategy differences: **Small funds often pursue value-oriented, lower-leverage deals with higher risk premiums, while mega funds target larger, more stable companies with higher leverage and lower risk. These structural differences help explain the alpha patterns across fund sizes.**

Executive summary

Small and mega private equity funds outperform
We analysed the performance of 586 buyout funds in the Americas, primarily US-focused, spanning vintages from 2013 to 2023. Using privateMetrics® indices and the Excel plug-in tool, we calculated alpha performance across the fund universe. By segmenting funds into size buckets, we observe that smaller and lower mid-market funds achieved higher median IRRs and alpha. In the smallest bucket (<$500m fund size), median alpha observed was +5.6%. At the top end of the market, mega buyout funds also produced positive alpha. Funds with greater than $5bn of committed capital showed median positive alpha of 1.77%, displaying the benefits of scale at the very high end of the market. The upper middle market delivered the poorest results in our analysis for the Americas. For Europe, we had a smaller sample (129 funds), and the performance was more mixed. Small and mid-market funds had higher median IRRs and alpha, while the mega buyout segment underperformed.

Dispersion narrows with size
More extreme positive alpha is observed in smaller funds. As fund sizes increase to $5bn and beyond, extreme outperformance is less frequently observed but the overall return dispersion profile is narrower. Fewer outsized returns but also fewer major negative alpha funds. This is also true on the downside where more pronounced negative returns are observed in smaller funds. Median market return (beta) also declined as we moved from the smallest to largest size quartile, potentially indicating a difference in riskiness of the assets in small versus very large funds.

Systematic risk factors explanation
Mega buyout funds pursue the largest transactions, which generally are less liquid and thus warrant a higher risk premium. This is balanced against the higher quality of businesses and greater leverage employed in very large transactions, signalling a lower risk asset. Small buyouts tend to be value-oriented investments with lower quality earnings, as evidenced by the significantly lower leverage levels employed in small buyout transactions. These characteristics would suggest higher risk premiums in this segment. The high dispersion in alpha also supports the idea of it being a riskier segment of the market.

Manager incentives
The fee model in the private equity industry encourages managers to capitalise on success and scale by raising ever larger funds. Rather than executing more deals of the same size, the model encourages doing a similar number of deals of larger size to benefit from the increased scale. This leads to the most successful long-standing managers ending up in the mega cap space, after managing many funds of increasing size over time. This may also indicate that the mega cap universe is disproportionately represented by strong managers, partially explaining the performance at the top end of the market. Further, delivering alpha at scale is valuable as many institutions may not have the resources to comb the small cap market.

Methods and tools

We utilised a funds database containing over 800 private equity fund cash flows for the 2013–23 vintages. We then used the privateMetrics® indices to calculate alpha by employing the private market equivalent approach. Much like the public

market equivalent, fund cash flows were assumed invested in the private2000 index, matching the inflows and outflows of the underlying fund cash flows. Second, the fund was benchmarked against a thematic index reflecting the fund strategy to determine pure alpha, and then allocation alpha. As a reminder, we define the various components of fund IRR and alpha as follows:

Fund IRR = Market return + Total fund alpha
where:
Total fund alpha = Allocation alpha + Pure alpha

Fund size is assumed as a proxy for the size of assets in transactions. When private equity firms scale their fund size, typically they move 'up-market' and buy larger assets while keeping the total number of deals constant or only increasing modestly. This is consistent with Braun et al (2022). Often the managers move up market and then seed a new fund that targets the previous deal sizes. Mega funds, such as KKR's flagship, pursue the largest deals in the market. However, KKR, the company, has seeded many strategies to pursue mid-market or sector specific themes.

Prior studies on size and performance

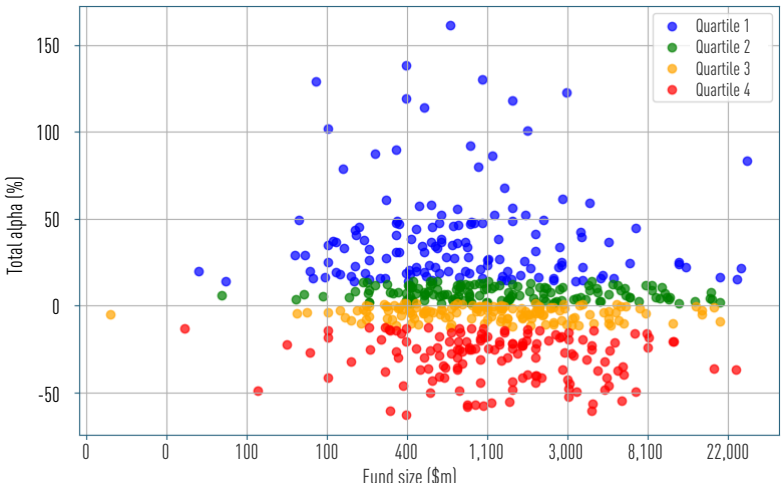
The most recent research on the relationship between size and performance in private equity was completed by Braun et al in 2022, where this topic was analysed both at the asset and fund level. The researchers used the public market equivalent approach to assess gross value add (GVA) of managers. The report found that there was a negative relation between relative returns and both deal and fund sizes. The researchers used 942 buyout funds and over 13,000 deals for the time period 1974 to 2011. The research also found that there was higher dispersion among smaller funds that narrowed with increasing fund sizes. The research focused on GVA, which combines the excess returns over a market index with the amount of dollars deployed. Thus, with this approach, a very large fund with modest alpha may have greater GVA than a small cap fund with much higher alpha. They also found that managers do not increase quantity of deals as fund size increases.

Other research on this matter, including Kaplan and Schoar (2005), finds no impact of fund size on performance, using the public market equivalent for buyout funds.

Alpha by fund size

Figure 1 outlines the total alpha for funds with vintages from 2013–23, split into alpha quartiles. There are 586 Americas-focused funds across the vintages.

Figure 1. Total alpha versus fund size – Americas 2013–23 vintages



Source: privateMetrics

In this case, Quartile 1 (blue) represents the highest quartile alpha generators within the Americas fund universe, while Quartile 4 (red) represents the worst performing funds. As figure 1 indicates, most of the extreme high alpha performing funds were smaller, typically less than $2bn in size, with most less than $1bn. This also appears true with the negative performance, where small to lower middle market funds in the fourth quartile of alpha producers showed more severe negative returns than mega buyout funds. Overall, the dispersion in alpha was narrower as fund sizes increased beyond $5bn, indicating there may be differences in asset risk when comparing mega funds to the small and lower middle market segments.

Table 1 further breaks out the return and alpha metrics along four key size buckets. The first bucket consists of small funds with fund size under $500m. Funds in this category would have completed very small buyout transactions. Assuming 10–20 deals per fund, average equity cheques would be ~$25m–50m per transaction. This bucket showed the highest median IRR and total alpha of the four buckets. It also had the highest market component (beta) of the four buckets. Strategies in this segment may have a 'value' bent, thus accounting for the larger dispersion in returns. In other words, the assets overall may be riskier than larger size buckets.

Likewise, the second bucket, comprised of funds with sizes between $500m and $1bn, showed the next strongest median IRR and alpha. Assets in this bucket share characteristics with the smallest funds. The upper middle market to large buyout segment ($1bn–5bn) funds showed the lowest median IRRs and alpha, while also showing very large dispersion. Conversely, the mega buyout category, funds in excess of $5bn, showed better results with positive alpha.

Figure 2 shows this at an even more granular level based on fund size deciles. The small and lower middle market segment showed more likelihood of positive alpha generation relative to the upper middle market (deciles 6-9). The mega funds in decile 10 (>$5bn fund size) also showed positive median alpha. We can observe tighter dispersion in decile 10 relative to others, perhaps implying that the mega funds pursue lower risk assets.

Table 1. IRR and alpha by size in Americas 2013–23 vintage

Americas n=586 (2013-23 vintage)		IRR			Total alpha		
Size buckets	Fund size	Bottom decile	Median	Top decile	Bottom decile	Median	Top decile
1 (154)	<$500m	-11.1%	21.3%	57.3%	-19.4%	5.56%	43.7%
2 (137)	$500m–1bn	-29.3%	16.9%	57.2%	-30.2%	3.68%	44.9%
3 (225)	$1bn–5bn	-32.5%	10.1%	39.9%	-36.9%	-1.56%	25.9%
4 (70)	>$5bn	-22.2%	13.5%	28.3%	-35.2%	1.77%	21.7%

Source: privateMetrics

The performance of the upper mid-market and large segment (excluding mega funds) was the most surprising. While many champion these segments as the higher alpha potential parts of the market, our analysis finds that they underperformed the small, lower middle market and mega cap space.

Turning to Europe, figure 3 shows results across fund size and total alpha for 129 funds with vintages from 2013–23. In this case negative results were more pronounced at larger fund sizes.

Similar to the Americas focused funds, smaller European buyout funds show a large presence of significant outperformers, indicating higher chances of finding a 'homerun' fund. The mega fund segment (>$5bn fund size) had noticeably poorer results than their US counterparts. We observe a large number of third and fourth alpha quartile performers at the large end. The mid and upper middle market had relatively better performance.

Manager incentives, fund size and deal size

As fund sizes increase, management fees and carried interest are surprisingly sticky, despite the gains from scale in the asset management industry. Typically, private equity funds charge 1.5–2% for management fees and 20% carried interest above an 8% hurdle. These fee levels do not change with fund size, with mega funds charging similar fee percentages as very small funds. According to research, the elasticity of management fees with respect to fund size is just -0.06 (Braun et al [2022] and Lim [2021]).

This creates a massive incentive for managers to raise larger successor funds to scale and move up market, by executing large deals. If we view the management fee stream as an annuity and a higher degree of certainty, then the manager can significantly increase the value of the management company by increasing fund sizes. Smaller funds (eg, below $300m), likely need the management fees to fund operations, team expenses, with limited residual value to justify a large value for the manager. For the small fund, the carried interest represents the largest potential residual value. At the large and mega cap level, the management fees are far higher than what is required to run the day-to-day business. We can see the evidence of this in the listed private equity manager space, where valuations are primarily established from capitalised fee-related earnings, comprised mostly from management fees.

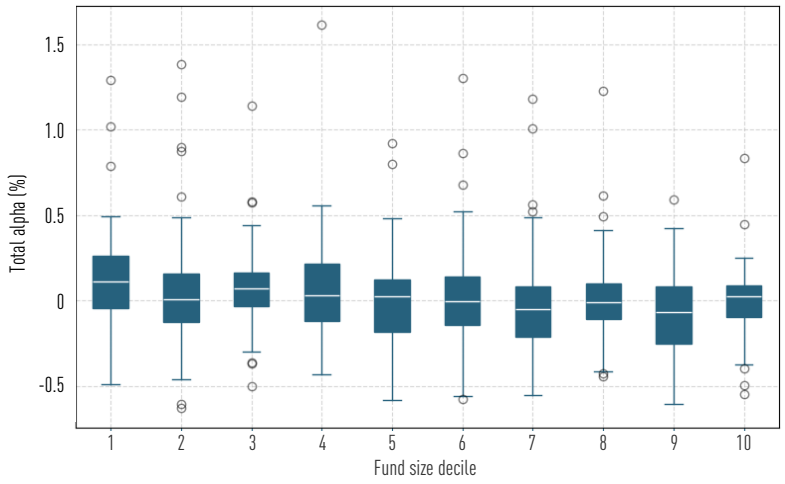
This greater importance of management fees as a component of manager value may drive mega funds to a less risky strategy. At small fund sizes, maximising the carry (call-option) is desirable, but at mega fund sizes, preserving the large management fee stream (bond-like) favours limiting volatility.[1]

Do the best managers graduate to mega funds?

Related to the prior point, the managers that have scaled to the mega buyout space were all smaller funds at one point and delivered strong returns, attracted more capital and moved up market. There are fewer assets to chase but also far fewer players going after the assets. There are no 'emerging' mega cap managers. All

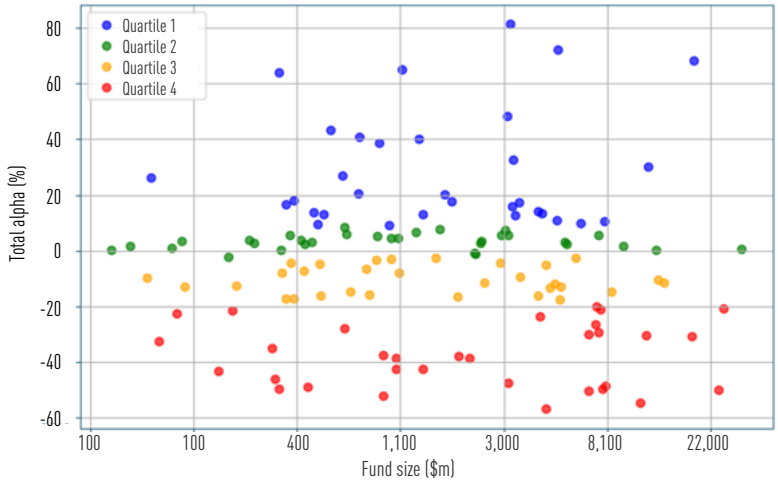
1 See Sorensen, Wang and Yang (2014).

Figure 2. Alpha by fund size decile – Americas 2013–23 vintage



Source: privateMetrics

Figure 3. Total alpha vs fund size – Europe 2013–23 vintages



Source: privateMetrics

Table 2. IRR and alpha by size quartile in Europe 2013–23 vintage

Europe n=129 (2013-23 vintage)		IRR			Total alpha		
Size buckets	Fund size	Bottom decile	Median	Top decile	Bottom decile	Median	Top decile
1 (35)	<$500m	-25.5%	7.2%	30.0%	-43.2%	-2.13%	16.7%
2 (19)	$500m–1bn	-16.5%	21.0%	50.2%	-27.9%	6.03%	38.9%
3 (43)	$1bn–5bn	-34.2%	14.4%	44.8%	-38.4%	2.90%	32.7%
4 (32)	>$5bn	-44.7%	-3.6%	22.7%	-49.6%	-12.96%	10.9%

Source: privateMetrics

have existed for decades and navigated their way up market over time. This may also partially explain the ability to generate alpha at scale. Moreover, they offer a valuable service to LPs, by providing access to the private equities market at scale. Some LPs that need to deploy larger allocations can achieve this efficiently with the mega cap managers. Not all LPs have the resources to research and evaluate the thousands of small cap managers in the market.

At the smaller end of the market, there will be a mix of new and emerging managers, as well as those not able to raise larger funds, due to performance or other reasons. It makes sense that the small end of the market sees high dispersion in results. Either they outperform and raise large successor funds, or they languish as small cap managers, with some ultimately failing to survive.

Systematic risk factors explanation

Mega buyout funds pursue the largest companies in the private equities market. The companies tend to be more illiquid due to a more limited buyer pool, thus warranting a higher risk premium. Despite the smaller number of targets relative to the small cap market, there are a limited number of mega buyout funds with the capital to execute the largest transactions.

Smaller company buyout transactions typically look more like value (Chingono and Rasmussen [2015]), than growth investments. The company profile is usually mature rather than early stage. Value companies tend to trade at lower multiples and offer higher risk premiums, an explanation consistent with the alpha generation for the small cap segment. There may be more information asymmetries in smaller companies, increasing risk, contributing to higher dispersion. Further, given the scale benefits of larger deals, an investor willing to invest time and resources in the small cap space may be rewarded with higher returns. The greater dispersion of alpha (big winners and big losers) indicates the risk in the strategy, thus warranting a higher risk premium.

Smaller companies use considerably less leverage (Stepstone Group [2023]) than large and mega buyout transactions. Often there can be a 1.5–2x gap in debt/Ebitda employed in small versus very large transactions. This is likely due to the quality of the business and ability to service debt and thus signals that the smaller company should earn a higher risk premium due to its higher risk profile. Using the Comps Builder in privateMetrics, one can observe leverage levels covering various time periods, and across PECCS segments.

Conclusion

Using privateMetrics indices as benchmarks, we find that smaller US buyout funds exhibit greater potential to generate outsized alpha, but they also carry a higher risk of delivering significantly negative alpha. This heightened volatility is influenced by systematic risk exposures and manager incentives that shape both asset selection and strategy. At the other end of the spectrum, mega-cap US buyout managers have also demonstrated an ability to generate alpha – albeit at lower levels – though doing so at scale still translates into substantial dollar value for LPs. Consistent with prior research, we observe a negative relationship between fund size and performance, along with a narrowing of return dispersion. This may reflect a shift toward lower-risk assets and strategies as fund size increases. The difference in alpha may partly stem from greater inefficiencies in the smaller end of the market, where there are more companies and untapped opportunities to augment value. In contrast, LPs investing mainly in mega funds will likely track the broader private equity market, with less over/under performance.

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