TOTAL PORTFOLIO APPROACH & PRIVATE ASSETS

Part III: Private Assets Risk Factors Exposure

March 2026

This paper is the final piece in a three-part series on the Total Portfolio Approach (TPA). It explores mapping factor exposures of private assets to total portfolio desired factor exposures. We look at some of the challenges in mapping private equities to an Equity factor and implications for those with significant weights or managing desired exposures with listed assets. We will utilise privateMetrics and infraMetrics alongside listed asset indices to quantify economic risk exposure. This can then be used to understand the role and behaviour of private assets within a multi-asset portfolio.

Executive Summary

TPA with Private Assets: A Total Portfolio Approach requires private assets to be incorporated within a unified risk framework alongside listed assets. Using privateMetrics® and infraMetrics® indices enables this integration by providing asset level indices with market-based pricing, monthly data, and realistic risk and return estimates. This allows private assets to be analysed robustly across different macroeconomic environments, overcoming the limitations of both infrequent and smoothed valuation data, which is endemic to the industry.

Interest Rate Regime Change: We examine the performance of private and listed assets across two distinct periods: 2014–2021 and 2022–2025. The earlier period was characterised by low and declining real interest rates, which ultimately turned negative in 2021–2022. During this environment, private equities significantly outperformed both listed equities and infrastructure equities, behaving like a high-beta exposure to the "equity factor", or listed global equities. In contrast, since 2022, private equities have materially underperformed listed equities.

Measuring Equity Exposure with privateMetrics® and infraMetrics®: Because private equities' covariance with listed equities is time varying, actual portfolio exposure may differ materially from allocation weights. This creates challenges for institutions targeting specific risk exposure levels, as portfolios can unintentionally become over- or under-exposed to growth. With privateMetrics and infraMetrics, these relationships can be measured allowing for adjustments to listed assets to maintain desired total portfolio exposures.

Private Equity and Interest Rates: Private assets are particularly affected by rising interest rates through multiple channels, including higher debt servicing costs, valuation compression, reduced exit activity, and shifting asset allocation preferences. These dynamics may differentiate them from listed equities and partially explain their recent relative underperformance. This reinforces the need for asset level private equities and infrastructure equities indices that capture the dynamics in their respective markets.

Data and Methods

Drawing on data from infraMetrics® and privateMetrics®, this paper illustrates how market-based private asset data can be used to quantity risk exposures in private assets and how that can be utilised in quantifying desired risk exposures alongside listed assets.

Both infraMetrics® and privateMetrics® databases can be used to download monthly index prices and risk metrics for private infrastructure equities, private infrastructure debt, and private equities. The flagship indices, infra300 and private2000, represent broad market indices diversified by sector, geography, and risk profile, best capturing the systematic risk of their respective markets. Both represent excellent starting points for capturing systematic risk and returns in their respective markets, private equity and infrastructure. Find infraMetrics indices (here) and privateMetrics indices (here). Further, our MSExcel Add-in allows for seamless download of the index data (see here).

A brief description of each index is below:

The infra300 index is a representative set of 300 unlisted infrastructure companies. The companies are selected to form a representative sample by TICCS® categories from an underlying universe of close to 9100+ firms in 27 countries. The index is represented globally in both corporate and project finance companies.

The private2000 index includes the top 2000 private companies by value across 30 countries and diversified by sector. The companies are selected to form a representative sample by PECCS® categories from an underlying universe of close to 1 million firms.

Mapping Private Assets to Risk Factors

Within a TPA framework, once a risk budget has been approved and set, an institution may target certain risk exposures to achieve its return objective.[1] This will depend on the type of institution: for a pension fund or endowment, there may be a higher desired exposure to growth or equity assets to meet long term return requirements; for an insurance entity, the desired equity exposure may be lower, and interest rate exposure higher to manage duration.

In figure 1, we look at a stylised mapping of desired risk exposures and how it connects to traditional asset classes or investment opportunities. For example, a pension fund may target a portfolio that has a large weight towards growth assets (achieved via listed and private equities), while having meaningful exposure to real interest rates, inflation, and credit. For economic factor exposures, we follow existing research[2] to map total fund holdings to a small set of factors, including growth, interest rates, credit, and inflation. The economic factors are proxied by 'pure play' indices or assets that best capture the

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[1] This topic was discussed in TPA Part I & TPA Part II of our TPA series.
[2] Greenberg, Babu, Ang (2016), Bass, Gladstone, and Ang (2017), Asl and Etula (2012), Elkamhi and Lee (2025).

desired exposure. For example, listed equities and private equities are exposed to the risk of equities markets, or global growth. This exposure can be proxied by an equity factor comprised of global equities returns. Other assets classes may behave like something in between bonds and equities, such as infrastructure equities or real estate. They would have exposure across the equity factor, real rates, and possibly inflation. Nominal government bonds capture the risk of having nominal price exposure, while TIPS capture risk associated with exposure to changes in real interest rates. Figure 1 shows a list of exposures and how they may map back to economic factors.

Additionally, the asset classes will also have unique style exposures. For private assets, depending on the portfolio holdings, there will be exposure to several style factors such as size, profit, leverage, or growth. This is also true across private infrastructure equities and debt.

*FIGURE 1: MACRO RISK EXPOSURES AND ASSET CLASS MAPPING*
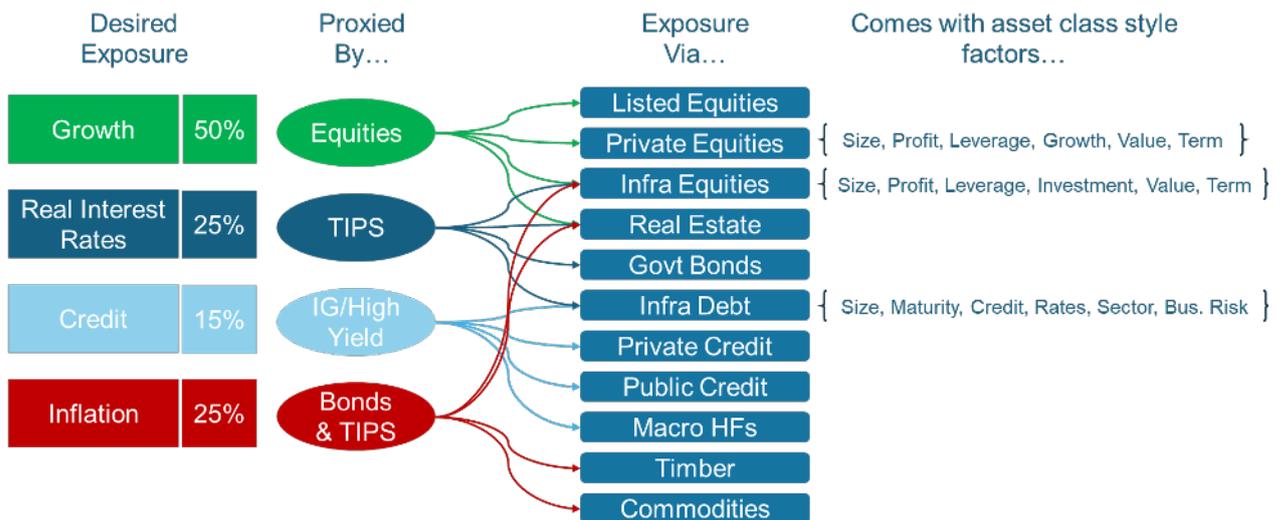
Note: Real interest rate and nominal exposure may overlap.

The definitions of proxies used for computing economic factor returns in this paper are:

- **Growth / Equity Factor:** returns on a global listed equities index (MSCI ACWI)
- **Real rates:** returns on inflation protected treasury bonds (TIPS)
- **Nominal rates:** returns on 7-10 year UST Bonds
- **Credit:** returns on a long high yield bonds and short UST Bonds portfolio
- **Inflation:** returns on a long 7-10 year UST Bonds and Short TIPS portfolio

In figure 2, we show the cumulative performance of several privateMetrics, infraMetrics, and listed global equities indices (left panel), with returns of risk exposure proxies (defined above) in the right panel.

FIGURE 2: ASSET CLASS PERFORMANCE (LEFT) AND ECONOMIC RISK FACTOR EXPOSURE (RIGHT)
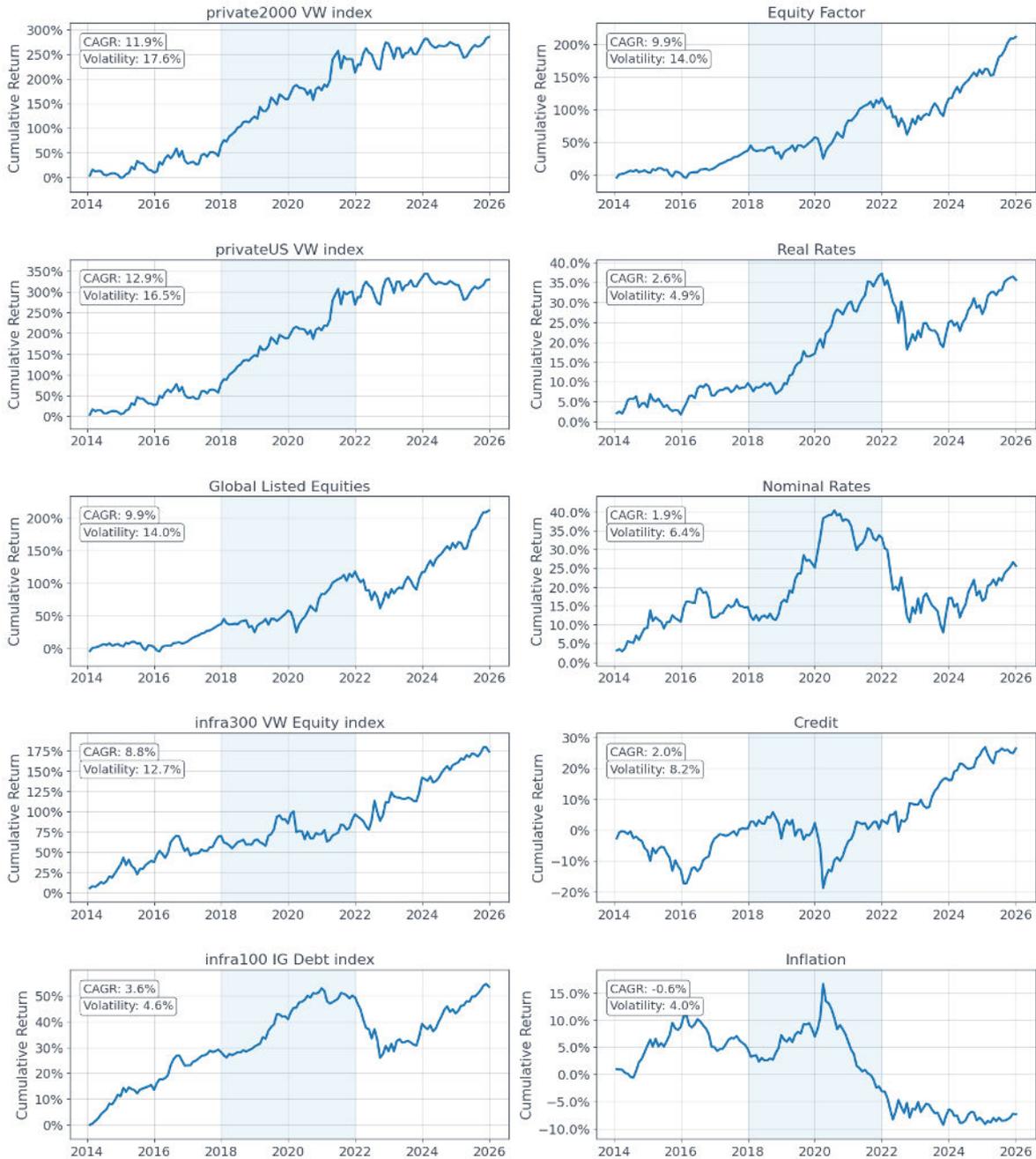
Source: privateMetrics, infraMetrics, Bloomberg. Returns are in USD and before fees. Global listed equities – MSCI ACWI USD. Infra300 and Infra100 returns are in local currency units.

As we can see in Figure 2 (left panel), private equities generated the highest returns (with the highest volatility), followed by global listed equities, infrastructure equities, and infrastructure debt.

Looking at different timeframes, from 2018-2022 for example (shaded blue), both listed and private equities performed well, but private equities outperformed considerably. This coincided with a period of very strong returns for interest rate exposure (figure 2 - right), with real and nominal yields falling, and real yields becoming negative for parts of 2020 to

2022. The extraordinary low yields create ripe conditions for private equities, leading to valuation gains and strong exits. When inflation expectations increased beginning in 2021, the private2000 index sold off and returns have since languished in the higher rate environment. Global buyout deal volumes declined by 33%[3] from 2021 to 2023, and have only recovered modestly since then. Listed equities initially sold off in 2022 but have since performed well, implying different sensitivity to changing regimes. Private infrastructure equities have also faired better since an initial sell-off in 2022, suggesting that despite meaningful duration exposure, the ability to pass on inflation has in aggregate helped the asset class adapt to the higher rate environment.

We can see this in more detail in figure 3. In the left panel, from 2014 to 2021, private equities materially outperformed listed equities, with a 15.3% return vs 10.2%. In the latter period, characterised by high interest rates, the trend reversed. This is true whether we look at large cap or small cap indices, however large caps have outperformed to a greater extent.

FIGURE 3: PRIVATE VS LISTED EQUITIES RETURNS IN LOW VS HIGH INTEREST RATE ENVIRONMENTS
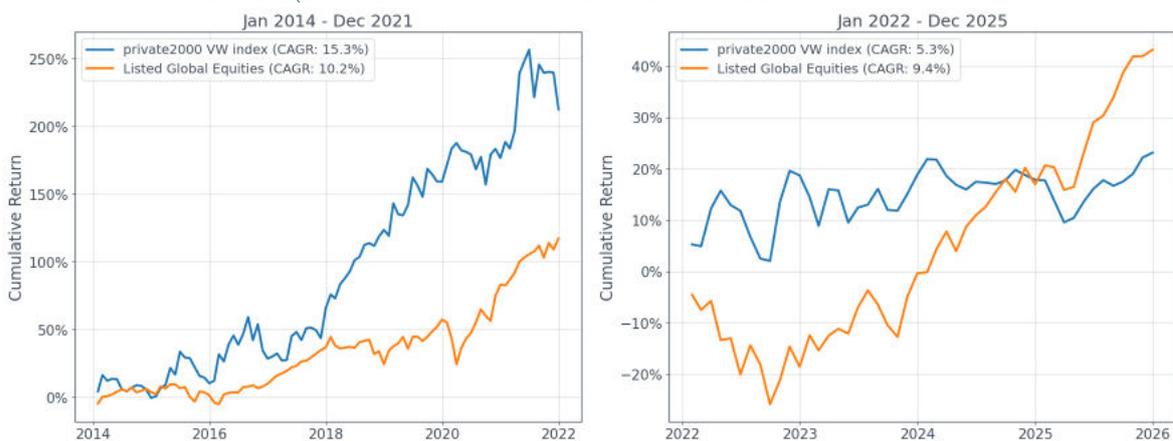
Source: privateMetrics, Bloomberg.

In a TPA framework, one attempts to define all equities exposure (public and private) via an equity factor derived from listed equities. By definition, the listed portion of the portfolio will have a beta very near 1 throughout. However, the private equities beta to the equity factor may vary depending on the interest rate environment. In certain environments, private equities may show a high beta to the equity factor, while in others, the beta may be meaningfully below 1. For infrastructure equities, the beta to the equity factor is generally lower, but also varies by macro regime.

Figure 4 shows the betas of the private2000 and infra300 indices to the equity factor for the period 2014 to 2025 and split into two periods reflecting the different interest rate environments. Examining the full period from 2014 to 2025, private equities provided a higher beta to the equity factor, and thus more equity exposure than implied by simple allocation weights (eg beta of 1.1).

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[3] Bain 2026 Private Equity Outlook

But if we look closer, this was very much regime dependent. Private equities acted as very high beta from 2014 until the inflation shock of 2022. This period was characterised very low real and nominal interest rates. In the period following (2022-2025), the relationship reversed, with private equities tilted portfolios showing betas well below 1. Lower returns and lower return volatility led to reduce overall equity factor exposure. This is particularly relevant today as many institutions are grappling with the diverging return performance of their listed and private assets portfolios.[4] In effect, a fund's total equity exposure, once looking through to listed and unlisted assets, may be different than what is implied by asset allocation weights. One approach is to take a long term view and assume the average beta over time will represent the approximate exposure, accepting interim deviations. Alternatively, if an institution wants to maintain a consistent target exposure, by measuring equity exposure across the universe of listed and private assets, the overall equity exposure could be adjusted with a *completion portfolio*. As private asset weights are difficult to adjust in the short term, listed equities could be adjusted to ensure portfolio is aligned with desired exposure.

FIGURE 4: BETA TO EQUITY FACTOR IN PRIVATE INFRASTRUCTURE AND PRIVATE EQUITIES

Source: privateMetrics, infraMetrics Bloomberg. Using monthly returns for listed and private equities in USD. Private2000 VW and infra300 VW Index returns in USD. Assume long term PE to Listed Equities correlation is 0.85. Private Equities Beta is a product of long term correlations and relative volatility.

These results can be applied by calculating the implied equity exposure for an investor with listed and private asset holdings. In this example, we assume an investor is targeting a 50% equity factor exposure and splits their equities allocation between listed and private equities (22.5% weight to each), with additional exposure through an allocation to infrastructure equities (10% weight). Figure 5 shows the equity exposure of three asset classes for the 2014-2025 period, implied by their betas to the equity factor. Equity exposure can vary materially across different periods. Over the full period, the exposure is approximately 51.4%, broadly aligned with a 50% target. Any modest deviation from

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[4] Canadian pension funds count cost of private equity slump

target could be managed through small adjustments to listed equity exposure, for example via an overlay.

However, the picture differs by sub-period. From 2014 to 2021, the higher private equity beta results in equity exposure exceeding the target, while in the later period the blended exposure falls meaningfully below target, at just over 43%.

Absent active adjustment, a relatively static allocation can therefore lead to materially different effective equity exposure across regimes. This creates the risk of either exceeding the intended risk budget or, conversely, taking insufficient risk and failing to meet return objectives.

Importantly, this does not reflect the underperformance of a particular private equity manager or a pension fund, but rather the "beta" of the private equities market.

FIGURE 5: EQUITY EXPOSURE RELATIVE TO TARGET EXPOSURE
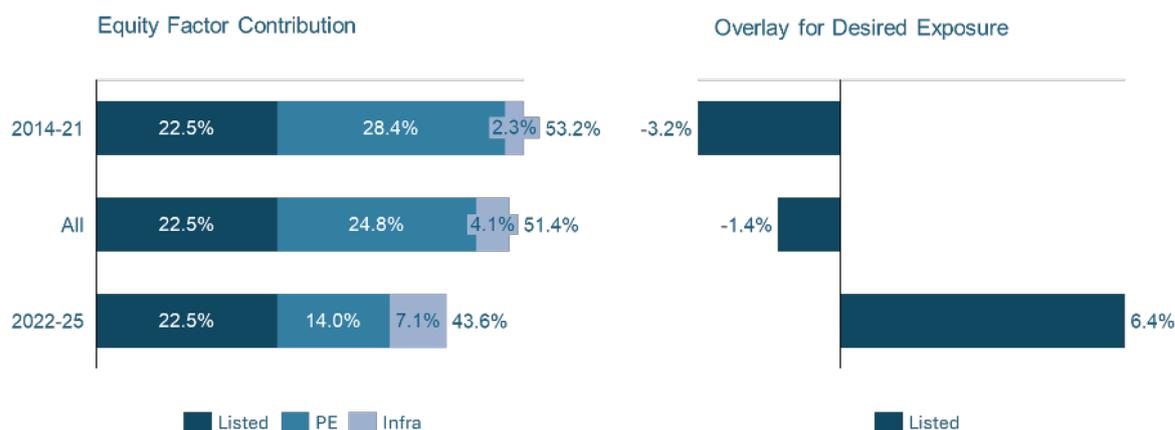
Source: privateMetrics, infraMetrics. Stylised results based on 22.5% weights to private and listed equities, 10% weight to infrastructure equities, and a 50% target equity factor exposure.

The equity factor is not the only important underlying factor exposure found in a multi-asset portfolio. In the next session, we explore how performance divergence of private and listed equities may be related to the interest rate environment. Private equities, as more leveraged assets, may be more sensitive to sudden changes in real interest rates and inflation than listed equities. Moreover, there are several ways through which interest rates impact private equities, outside of the direct impact on the discount rate.

Interest Rate / Inflation Shock

As discussed thus far, under a TPA framework, a common approach is to map or proxy private equities through listed equities exposure. In theory, private equities should load intensively on a listed equities index, and largely magnify listed equities returns, via higher asset level leverage. In this section, we discuss the multiple channels through which interest rates may affect private equities, from asset allocation to debt servicing and valuations.

Interest rates can impact private equities returns in at least four ways:

- **Asset Allocation:** The historically low interest rate environment increased liabilities for pension funds and other liability driven institutions. This encouraged institutions to seek higher returns in riskier asset classes, including private assets. Private equities, among the highest risk/return asset class, was a clear beneficiary from 2008 to 2022. The increased allocations may have contributed to reduced risk premiums[5], improving returns. With higher interest rates since 2022, other less risky asset classes have become relatively more attractive. The tailwind from increasing allocations is likely over, if not reversing.
- **Debt Servicing:** Private equities (buyouts) carry substantial leverage (4.5x-5.5x EBITDA[6]), most of which is floating rate. The increased interest payments shift cash flow that would otherwise flow to equity, to debt holders. Unless operating earnings adjust commensurately, this can negatively impact equity returns. This may also constrain additional leverage capacity, limiting growth opportunities, especially via M&A or roll-up strategies, common in private equity.
- **Valuations:** Higher rates tend to compress valuation multiples[7]. Less leverage and more expensive buyout financing make the IRR math more challenging, leading to lower multiples, hurting private equities returns. Growth opportunities - particularly M&A - are more discounted.
- **Exits / Re-upping:** There is a pro-cyclical relationship[8] with exits and private equity allocations. Given the uncertainty around appraisal valuations, LPs value realised exits and this is a key signal and consideration for investing in successor funds. Importantly, exits provide the distributions that can be re-invested. The high interest rate environment since 2022 has contributed to an exit drought[9], making it difficult for institutional investors to commit to new funds.

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[5] The private2000 discount rate dropped to a low of 7.6% (median) in 2022 after years of low rates.

[6] Pitchbook

[7] The privateMetrics median EV/EBITDA for the private2000 index has declined over 20% since peaking in 2021/22.

[8] Ivashina (2022).

[9] FT

- **Company Size:** Private equity companies are much smaller than the mean or median company in major listed indices, even small cap indices. An interest rate shock may disproportionately impact smaller companies.

Taken together, the impact of a sudden change in interest rates is more nuanced than in listed equities. Certainly, listed equities are impacted via the valuation channel, but the lower leverage levels, lack of reliance on the exit and re-upping mechanism, and perhaps less impacted by asset allocation changes given its core asset class standing. In other words, the two operate in distinct markets with different dynamics. Moreover, some of these impacts are felt over time, particularly asset allocation, debt servicing, and the exits / re-upping feedback loop. We can see this more clearly looking at performance across various indices over recent years.

Figure 6 shows financing costs for US private equity buyouts since 2018. Base rates dropped to near zero in 2020/21 and all in financing costs were below 600ps. By 2023, all-in financing costs were in excess of 1,100 bps, up almost 600bps from 2021 levels. Financing costs have come off since the peak but remain high relative to earlier periods. The impact of this dramatic rise in rates has been felt in private equities for 3+ years now, compressing valuations, returns, and exit activity.

FIGURE 6: SOFR PLUS SPREAD IN US LEVERAGED LOAN MARKET BY YEAR

Source: Pitchbook, Capstone.

In figure 7 we observe how private and listed equities performed from 2014 through the end of 2021, and then from 2022 to end of 2025. We include two smaller cap indices (Russell 2000 and S&P 600 small cap index), and two large cap indices to compare how various indices performed leading up to the interest rate shock, the drawdown period, and the recovery.

Figure 7 (left) shows that the privateUS index delivered a 17.7% CAGR during the 2014-2021 period, while the private2000 index delivered 15.3%. These returns were well ahead

of listed equities indices, including small cap proxies such as the Russell 2000 or the S&P 600.

In figure 7 (right) we observe that the return dynamic shifted meaningfully from 2022 to 2025, with large cap equities outperforming, during which, smaller cap indices and private equities showed low to mid-single digit returns. This is a noisy period because it captures the inflation shock of 2021/22, subsequent drawdown, and post drawdown recovery which played out differently across the indices.

In the first half of 2022, most listed equities indices sold off ~20%. The private2000 and privateUS indices were down 12.3% and 9.3% respectively, largely in the back half of 2021. This can be observed in figure 8 (left). Following the drawdown, returns were much better in listed equities, both large and small caps. Though large caps have outperformed, small cap listed indices have also performed well, and much better than private equities.

FIGURE 7: COMPOUNDED ANNUAL RETURNS JAN 2014-DEC 2021 (LEFT), JAN 2022-DEC 2025 (RIGHT)
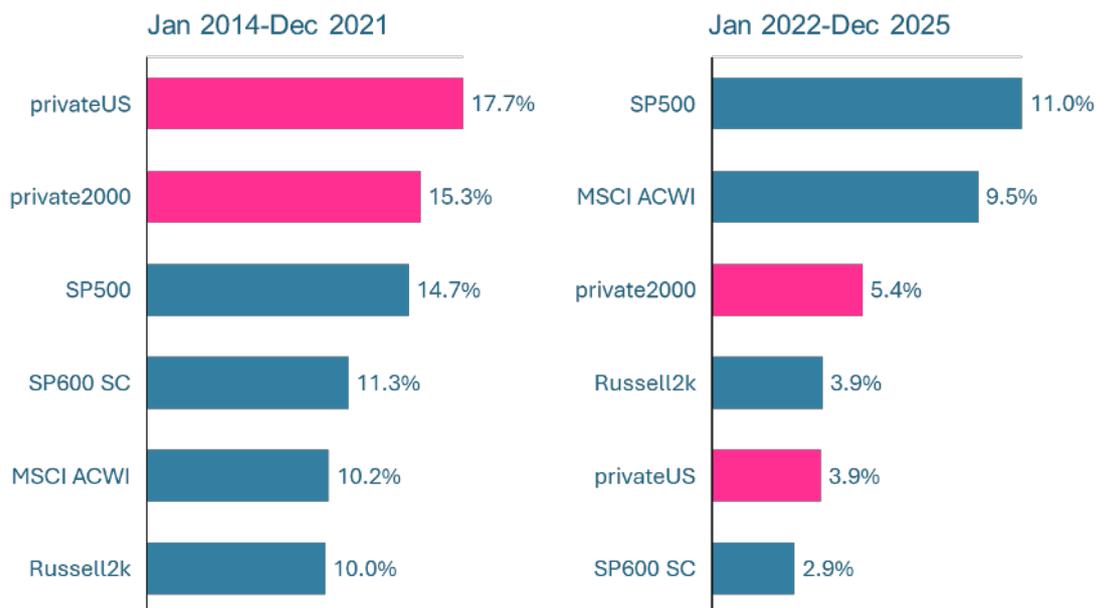
Source: privateMetrics, Bloomberg. Returns are in USD and annualised.

FIGURE 8: INFLATION SHOCK DRAWDOWN (LEFT), JUL 2022-DEC 2025 (RIGHT)

Source: privateMetrics, Bloomberg. Listed Indices drawdown from January 1 2022 to June 30 2022. For private2000 and privateUS, drawdown from July 1 2021 to December 31 2022. For comparison, Preqin PE index had max drawdown of 2.97% in 2022. Table 1 shows the compounded returns over the entire period, from January 2014 through to December 2025. Ignoring the interim shocks and returns, it appears that private equities outperformed most listed indices (before fees) over the period. But as we just showed, most of the private equities returns occurred prior to the increase in interest rates, while listed equities returns have been more balanced.

TABLE 1: EQUITY INDEX RETURNS: PRIVATEMETRICS VS LISTED INDICES

Period	private2000	privateUS	S&P 500	MSCI ACWI	Russell 2000	S&P 600 Small Cap
2014-2025	11.9%	12.9%	13.4%	9.9%	7.9%	9.9%

Source: privateMetrics, Bloomberg. Returns compounded annually to Dec 31 2025. USD.

Conclusion

The Total Portfolio Approach requires a clear understanding of how private assets contribute to overall portfolio risk. While exposures can ultimately be adjusted using listed assets, this must be grounded in a comprehensive view of the full portfolio. Using higher-frequency data from privateMetrics and infraMetrics, we show that private assets can be analysed alongside listed assets within a consistent framework, enabling more informed decision-making at the total portfolio level. Market-based pricing, combined with realistic assumptions for risk and return, allows for a more robust assessment of private asset behaviour. In particular, the availability of monthly data supports analysis across different macroeconomic regimes, without the limitations typically associated with low-frequency or smoothed data.This approach is especially relevant in the current environment, where the performance of private and listed assets has diverged.

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Access all privateMetrics data programmatically and build your own applications for private market investing and reporting

Index Catalogue

Browse our catalogue of hundreds of private equity, infrastructure and infra debt indices, inc. market indices like the infra300 and private2000, and thematic indices representing specific market segments.

Taxonomies

Query the PECCS® and TICCS® taxonomies used to create the privateMetrics universe. Access class codes, names and definitions to build your own index and comps customisations applications.

Index Data

Access a comprehensive set of performance and risk metrics for hundreds of private equity, infrastructure and infra debt indices tracking numerous geographies and segments.

Custom Benchmarks

Build custom benchmarks setting target weights by PECCS, TICCS, style and geography that align with your strategy. All index metrics are recalculated for you.
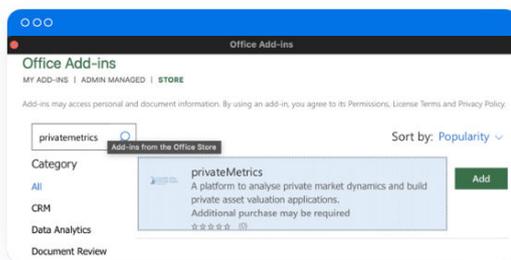
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Create customised comp sets using PECCS® and TICCS® segments, geography and systematic risk profiles. Get metrics like discounts rates and EBITDA multiples.

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The privateMetrics® Valuation Model

Our approach to the valuation of private companies is designed to maximise the available transaction and financial data in private markets and provide a standardised and systematic manner to update prices with every observed transaction.

First, we construct a multi-factor model of prices using a sample of observed transactions over time which can infer the unbiased and precise factor prices that investors pay for different characteristics of a private asset. Although every transaction is idiosyncratic or unique, in a large sample of transactions, the individual errors in each transaction price can be diversified away to discern the price attributable to each factor. Factor prices refer to the premium (or discount) that an investor is willing to pay to seek exposure to a specific factor of return in private companies. For example, observing the relationship between size and valuation among reported transactions, it can be inferred how much premium or discount an investor is willing to pay for purchasing a larger private company.

Second, an important and key application of this approach is that, with the estimated factor prices, say for size, it would then be possible to price unlisted private companies whose size information is available, irrespective of whether they are traded or not. This approach provides a more robust estimate for FV and enables the creation of representative indices of private companies.

Our approach's novelty is calibrating the model to newly observed transactions obtaining the factor price evolution over time, which allows us to update the valuation for all tracked unlisted private companies.

Common Risk Factors

If investors trade unlisted private companies from each other in mutually negotiated transactions, there must be some common characteristics that at least partially explain prices. For example, private companies that have higher profits or growth opportunities may be more valuable to investors than those that are not.

To arrive at a potential list of factors, we follow simple criteria that there needs to be an economic rationale for the factor to affect valuation. The factor should also be statistically related to the valuation. Moreover, the factor should also be objectively observable or measurable. With a potential list of factors, our factor selection is the result of a statistical approach, where the factors that can satisfactorily explain the variation in observed transaction valuations are included in the final model while trading off being parsimonious with being able to explain a higher variance in valuation. The privateMetrics asset pricing model uses five key risk factors as below:

- **Size**: Larger companies may be more complex, have higher transaction costs, and be less liquid, all of which can make them trade at a lower valuation per $ of revenue.

- **Growth**: As traditional PE strategies rely on growing the entry multiple, that may involve both increasing its top and bottom lines, i.e., revenue and profits. Thus, companies that can grow faster can be more sought after, making them more valuable.
- **Leverage**: Leverage can make a company riskier as it increases the risk of default. However, there is also a signaling effect of leverage, as companies with stable consistent cash flows can support a higher leverage, and vice versa. Thus, leverage is expected to influence the valuation of a company.
- **Profits**: More profitable companies have more predictable (less risky) future payouts and hence attract a lower risk premium, making them more valuable.
- **Maturity**: Younger companies have fewer track records and face higher information uncertainty. Studies have shown that firms with high uncertainty tend to be overvalued and earn lower future returns. Thus, the maturity negatively affects valuation.
- **Country risk**: Investors may require a high return when investing in a high-risk country, thus depressing the current valuation. In other words, in countries with lower risk, investors may be willing to purchase assets at a higher valuation as government policies may be more predictable with lower macroeconomic risks.

TABLE A1: KEY FACTORS, THEIR EFFECT ON VALUATION, & THE ECONOMIC RATIONALE FOR INCLUDING THEM IN THE MODEL

Factor	Definition (Proxy)	Effect on price	Economic Rationale	References
Size	Revenues	Negative	Larger firms are more illiquid and trade a lower price	Fama & French (1993)
Growth	Change in Revenues	Positive	Companies with higher revenue growth trade at a higher price	Fama & French (1992), Petkova & Zhang (2005)
Leverage	Total debt / Revenues	Positive	Companies that can borrow more have a lower cost of capital and a higher value	Gomes & Schmid (2010), George & Hwang (2010)
Profits	Ebitda Margin	Positive	Companies that have higher profits have a higher value	Novy-Marx (2013), Hou et al. (2015)
Maturity	Years since incorporation	Negative	Companies that are mature exhibit less growth potential and trade a at a lower price	Jiang et al. (2005)
Country Risk	Term Spread	Negative	Companies in high-risk countries face more uncertain prospects	Chen & Tsang (2013)

SOURCE: CALCULATED USING OVER 10K DEALS FROM PITCHBOOK, CAPITALIQ, FACTSET, AND OTHER PRIMARY SOURCES BETWEEN 1999-2022

Our factors have been documented in prior academic studies to be associated with valuation. We also include factors that have been identified as key determinants of valuation from a survey of private equity practitioners that we conducted in 2023. Table A1 summarises the key factors that we use in the model, how they are measured, each factor's effect we document in the data on average, the economic rationale for their inclusion, and citations for the work that underpins their inclusion.

Model Set Up

The privateMetrics asset pricing model uses the Price-to-Sales ratio of observable transactions (the entry price multiple) as the modelled variable. The model is estimated as the linear sum of the product of factor exposures and factor prices. The estimation

can then separate the systematic part of the valuation while leaving out "noise" in each valuation.

$$\frac{P}{S} = a + \sum_{k=2}^{K} b_k l_k + e$$

Following standard asset pricing notation, the factor exposure or factor loading is called a beta (β), and the factor premium is called a lambda (l) for the k factors in the model. a is the intercept and e is the noise or idiosyncratic part of the valuation.

Model Calibration

The privateMetrics model uses a carefully curated dataset of more than 10k+ unlisted private company investments going back two decades sourced from a wide variety of datasets including PitchBook, Factset, Capital IQ, fund manager reports, and other publicly available data sources.

We calibrate this model using new observations monthly to update its estimation of the price of risk of each factor. In other words, each transaction observed is then used to 'update' this model (i.e., obtain new ls) through a dynamic estimation (using a Kalman filter), which retains the memory of past ls while also allowing the new transaction to influence the relationship while keeping the average e close to zero. More details on the implementation of the model are available in our online documentation and Selvam and Whittaker (2024). The dataset covers all key segments of the market as shown in Figure1.

A good application of using the model to value unlisted private companies is to create a representative marked-to-market index of private companies that are regularly valued. The privateMetrics index universe in Figure 1 includes the constituents of the private2000® index constructed by Scientific Infra and Private Assets, which is developed on this shadow pricing idea and captures the performance of private companies in 30 countries globally that are important for private equity investors (read more about the index here).

How Precise are the Predictions across PECCS® Pillars?

To examine how closely the predicted valuations track the raw modelled valuations in transactions, we compute the average estimation errors of the full sample, and also by classes within each PECCS® pillar. What stands out is that although the model by design is expected to have lower estimation errors in the full sample, the within PECCS® class estimation errors are also very small. All the errors are within ±10%, reassuring that the model predictions on average even within each segment of PECCS® are reasonable. The errors are summarised in Table A2.

FIGURE A1: PRIVATEMETRICS TRANSACTION DATASET COMPARED TO THE PRIVATEMETRICS INDEX UNIVERSE BY PECCS PILLAR & CLASS
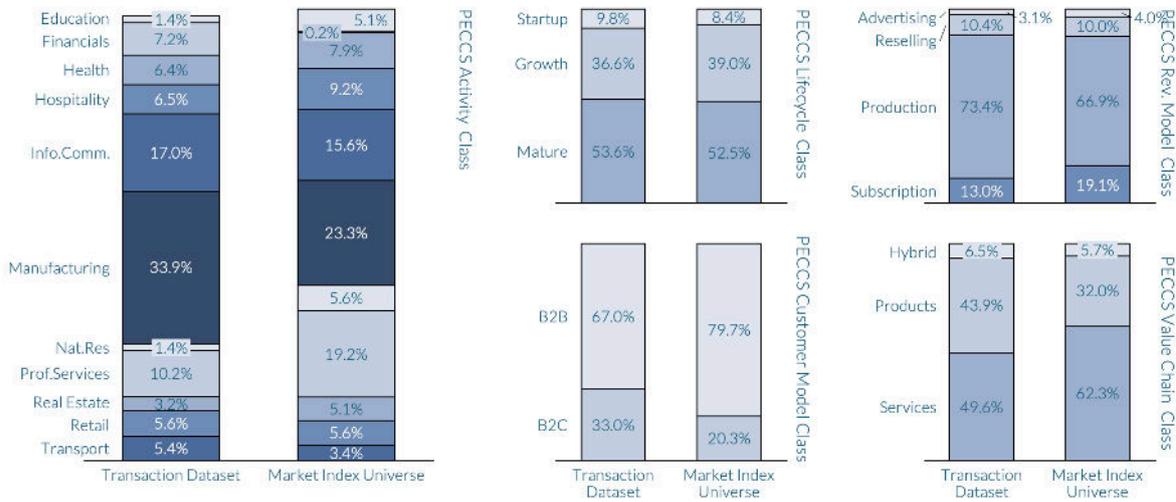
The most commonly used metric of valuation in private markets is EV/EBITDA as PE owners have the flexibility to alter the capital structure of their holding company and hence are more interested in operational profitability without factoring interest costs. However, our model is based on P/S because P/S is statistically better, stable, and not affected by loss-making companies. Thus, one may be concerned whether our predictions for EV/EBITDA might be biased.

To ensure that is not the case, we compute the EV based on the book value of debt and predicted equity valuation and divide the sum by the EBITDA to get a predicted EV/EBITDA and compare it to transaction implied ratios. Figure A2 presents the average predicted and observed EV/EBITDA by PECCS® activity classes. We find that the predictions are very close to the observed values, thus mitigating this concern.

TABLE A2: AVERAGE ESTIMATION ERRORS ACROSS PECCS® CLASSES, BASED ON THE DIFFERENCE BETWEEN TRANSACTED VALUATIONS AND FACTOR MODEL PREDICTIONS

PECCS Pillar	PECCS Class	Mean Estimation Error	PECCS Class	Mean Estimation Error	PECCS Pillar
PECCS Activity	Education and public	0.9%	Startup	0.1%	PECCS Lifecycle Phase
	Financials	1.8%	Growth	-1.7%	
	Health	2.6%	Mature	2.8%	
	Hospitality and entertainment	-1.1%	Advertising	1.2%	PECCS Revenue Model
	Information and communication	-4.4%	Reselling	4.6%	
	Manufacturing	2.5%	Production	2.9%	
	Natural resources	9.4%	Subscription	-6.9%	
	Professional and other services	3.3%	B2B	1.5%	PECCS Customer Model
	Real estate and construction	1.9%	B2C	0.9%	
	Retail	0.5%	Hybrid	0.6%	PECCS Value Chain
	Transportation	7.2%	Products	1.1%	
Full Sample		**1.1%**	Services	3.4%	

SOURCE: CALCULATED USING OVER 10K DEALS FROM PITCHBOOK, CAPITALIQ, FACTSET, AND OTHER SOURCES BETWEEN 1999-2022

FIGURE A2: PREDICTED VERSUS ACTUAL EV/EBITDA RATIOS BY PECCS® ACTIVITY CLASSES
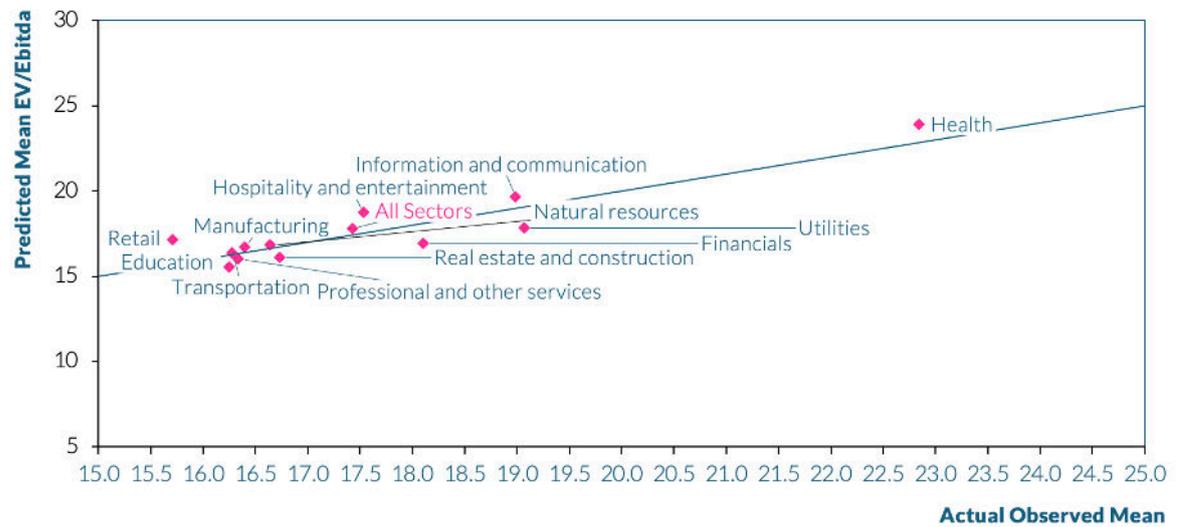
SOURCE: CALCULATED USING OVER 10K DEALS FROM PITCHBOOK, CAPITALIQ, FACTSET, AND OTHER SOURCES BETWEEN 1999-2022

About Scientific Infra & Private Assets

Our products come from the cutting-edge R&D of the EDHEC Infrastructure & Private Assets Research Institute, established in 2016 by EDHEC Business School. In 2019, we transformed this academic research into a commercial enterprise, providing services like private market indices, benchmarks, valuation analytics, and climate risk metrics. We take pride in our unique dual identity, bridging scientific research and market applications. In 2026, SIPA became part of PEI Group.

The EDHEC Infrastructure & Private Assets Research Institute (EIPA) continues to advance academic research and innovate with technologies in risk measurement and valuation in private markets, especially utilising artificial intelligence and language processing. SIPA supplies specialised data to investors in infrastructure and private equity.

Merging academic rigor with practical business applications, our dedicated team excels in integrating quantitative research into private asset investing. Our products, infraMetrics® and privateMetrics®, are unique in the market, stemming from thorough research rather than being ancillary services of larger data providers. We are the Quants of Private Markets, leading with innovation and precision.

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