
What Are Unicorns Worth?

A new approach to estimating the daily values of venture capital-backed companies.*

Morningstar Research

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Executive Summary

Private companies have grown to occupy a considerable share of institutional portfolios over the past decade, and many retail investors are beginning to gain exposure to private firms through managed investment products. The asset class has expanded considerably and offers exposure to a range of industries and geographies. Institutional investors — pension funds, insurance companies, endowments, and foundations — have increased allocations to private markets in the hunt for higher returns and to diversify away from public markets. As more venture capital-backed companies remain private longer, the opportunity set and access points for investors continue to evolve. Over time, we anticipate more investor portfolios to regularly contain both public and private equities.

Investor interest, particularly from the retail segment, is not without merit — venture capital investment is known for remarkable long-term returns. However, measuring the unrealized returns and potential risks of these businesses is easier said than done. Private fundraising rounds can be few and far between, making prices hard to determine. For most retail investors, portfolio construction relies on grounded capital markets assumptions that reflect the potential interplay between various assets. The addition of private company exposure into a portfolio may well be a boon to long-term accumulation. But these new exposures raise challenges for wealth advisors to identify appropriate allocations to meet investor goals. Without the proper tools, advisors may overstate or understate the rewards and risks in client portfolios that come from allocations to private markets.

One mark of the rapid growth of private markets is the burgeoning number of unicorns, or venture capital-backed companies valued at \$1 billion or more. The ranks of active unicorns now exceed 1,300 globally, with a collective value of roughly \$4.5 trillion. But the paucity of market benchmarks limits the ability of investors to understand the behavior and risks of private markets. Our mark-to-model approach allows for the creation of dynamic performance series to inform investors of market trends, allow better asset-allocation decisions, and serve as the basis for further benchmark development. The model uses three factors — past deals, comparable private company deals, and comparable public market valuations — to create implied mark-to-model valuations. Testing of the model conducted for the period between early 2021 and mid-2023 resulted in appropriate identification of 78% of major up and down rounds in deals for private companies.

The model is intended to be used to capture the broad behavior of private market segments as tracked through a basket of securities or indexes. It is not without limitations. To this end, the methodology's outcomes should be treated cautiously for valuing individual private companies.

* The original November 2022 version was authored by Haywood Kelly, Lee Davidson, Manan Agarwal, Sabeeh Ashhar, and Aditi Upreti.

Key Takeaways

- ▶ Private companies are difficult to value because quality data is scarce. Investors rely on third-party valuation techniques, which suffer from a lack of timely data or the subjectivity of human inputs.
- ▶ We estimate the mark-to-model valuations of private companies based on a statistical model that leverages past deals as well as contemporaneous private- and public-company comparable data.
- ▶ Key attributes of our pricing model include transparency, analyst-curated data inputs, and a focus on organic returns.
- ▶ Our pricing model dynamically adjusts to major market events by updating weights to past deals, public comparable data, and private comparable data on a daily basis.
- ▶ Our model is directionally efficacious, having been tested extensively on its ability to identify major up and down rounds for private companies in which valuations change by at least 5% during subsequent rounds. Based on testing conducted for the period between early 2021 and early 2023, our methodology resulted in appropriate identification of 78% of major up and down rounds in deals for private companies.
- ▶ Leveraging our mark-to-model valuations, we have created a first-of-its-kind family of indexes, the Morningstar PitchBook Global Unicorn Indexes, which bring transparency to the late-stage venture capital market.
- ▶ The model is not without limitations, and its outcomes are more suitable for use with a basket of securities or indexes than with individual private companies.
- ▶ This paper discusses the enhanced version of the mark-to-model pricing methodology. The original version was launched in November 2022. The new version offers significant improvements, with the new valuations being more reflective of the valuations suggested in secondary markets.

A Growing Opportunity

Private markets represent a growing opportunity set for investors. The asset class has seen threefold growth in the past decade, reaching over \$10 trillion in assets by the end of 2021. The number of global venture capital-backed companies is near 141,000, with an estimated 54,000 in the United States. Investor activity in venture capital has followed alongside these trends accordingly. In 2021, more than 24,200 unique investors made a deal into a U.S.-based VC-backed company; in 2007, that figure was below 3,500.

Despite the significant increase in private market investments, assessment of historical performance of this asset class remains uncertain because of limited data (Harris, Jenkinson, & Kaplan, 2014). In the absence of publicly disclosed periodic valuations of companies, returns on private companies are difficult to estimate individually or in aggregate, including private equity funds, industry groups, or sectors. This lack of regular valuation has significant implications for investors who desire transparency to effectively manage total portfolio risk, return, and distribution objectives.

The lack of regular valuations in private companies also creates the potential for illusions in private company returns when compared with public equity returns. Illusions of lower volatility and serial autocorrelation, for example, are caused by infrequent private company valuations. Private companies are exposed to the same macroeconomic competitive dynamics as public companies, and it makes sense that, as public valuations shift in response to changing market dynamics, private valuations should, too.

Indeed, numerous rounds of research (Block, 2019; Goetz, 2021; Harjoto & Paglia, 2010; Klein & Scheibel, 2012; Koeplin and others., 2000; Officer, 2007) have observed a relationship between public company valuations and private company valuations. Owing to the sparsity of deals, however, realized private market returns often tend to lag the realized public market returns up to the degree of sparsity in deals. This can lead to considerable valuation delays in the private markets—especially during periods of public market slowdowns as the deals in the private market tend to dry up. The already sporadic data points become even more scanty during such periods, thus widening the valuation gap further.

The methodology developed herein overcomes these shortcomings by leveraging past deals and comparable public and private factors for generating daily private company valuations. To this end, our valuation methodology is relevant for evaluating the valuations of private market benchmarks rather than the valuations of individual companies. In doing so, we have bridged some of the gap between the desire to add private company exposure into portfolios with the reality of modern-day portfolio management.

The paper is organized as follows. First, we discuss the intuitions behind the methodology for estimating implied valuations of private companies. Second, we share the key principles behind our mark-to-model pricing methodology. Third, we describe the methodology as well as key considerations and assumptions. Fourth, we disclose results from our efficacy testing. Next, we discuss limitations of our model and how they affect the valuations. Finally, we offer some concluding remarks about the methodology and discuss the scope for future research.

It should further be noted that all data used in this paper comes exclusively from PitchBook's database of private company deals and Morningstar's database of public market indexes.

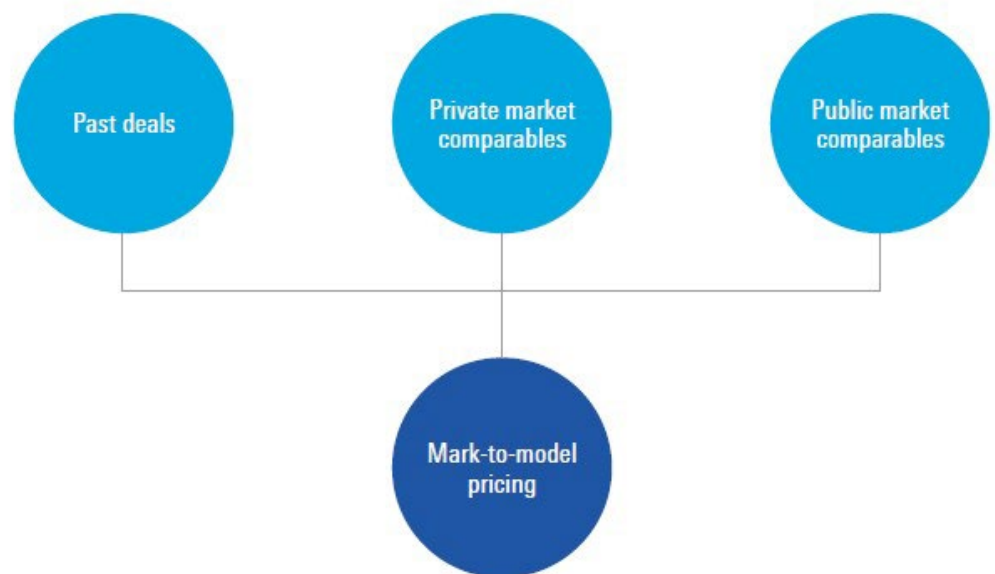
Estimating Implied Valuations for Private Companies

Within the private market ecosystem, companies report "pre-money" and "post-money" valuations. Pre-money valuation refers to the worth of a company before the latest round of funding, while post-money valuation refers to the latest value of the company afterward. These valuations are affected by a variety of factors, including the company's sector, technology, revenue, reputation, and growth rate. Various techniques attempt to estimate the value of private companies from early-stage venture companies to late-stage. The methods used for valuing early-stage venture capital companies include Berkus (Berkus, 2016), First Chicago, venture capital, comparable, book value, scorecard, and risk factor summation. Methods used for valuing late-stage venture capital companies include discounted cash flow method, the market approach, guideline transaction approach, and implied valuation from prior transactions. However, most of these methods rely on data that is available neither quickly nor publicly. Further, these methods require a certain level of human judgment, especially in their inputs.

To address some of these concerns pertaining to private companies, we have constructed an implied mark-to-model valuation methodology for unicorns using three valuation metrics:

- ▶ Past deal data
- ▶ Comparable private company deals
- ▶ Comparable public market valuations

Exhibit 1 Three-Factor Mark-to-Model Valuation Methodology



Morningstar is in a unique position to create this model, given our access to extensive databases of public and private companies through PitchBook. We have research teams dedicated to analyzing public and private companies, as well as to industries disrupted by high-value private companies, allowing us to identify robust comparable sets for many private companies.

We estimate the daily fluctuations in private market valuations by applying this implied pricing model daily to a basket of private companies. While there is uncertainty with the implied mark-to-model pricing of individual constituents in private markets, the estimation errors are less pronounced as we aggregate constituents to create an index. Our model enables us to create the first-of-their-kind private market benchmarks—the Morningstar PitchBook Global Unicorn Indexes—which capture the performance of unicorns globally. The indexes are designed to serve as barometers for the real-time impacts of macroeconomic forces—such as changes in interest rates, inflation, or other competitive shocks—on private company valuations. They allow investors to have informed expectations of return and risk, thereby aiding their portfolio diversification decisions.

Tenets of Mark-to-Model Pricing

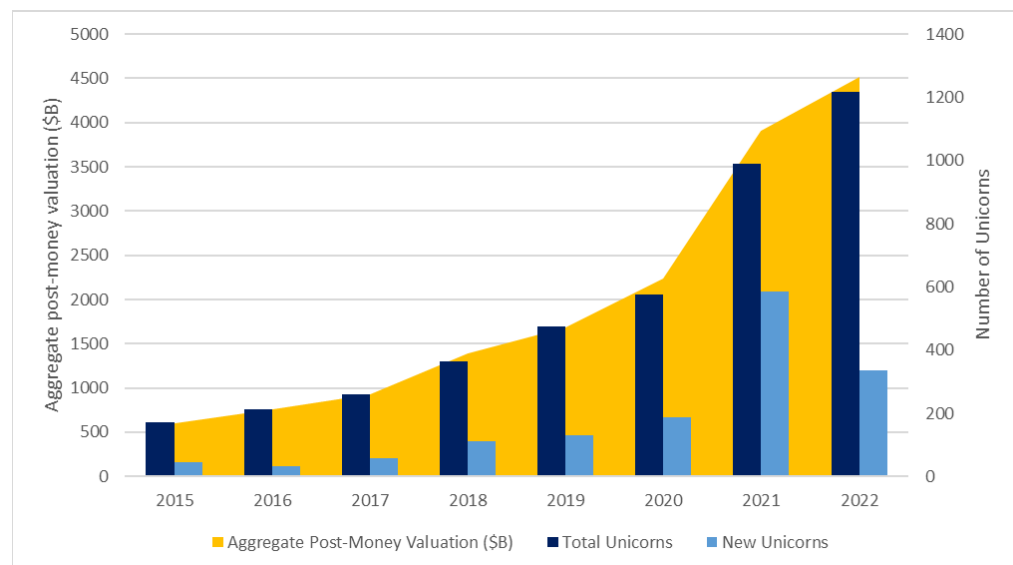
Below are some key tenets and assumptions of our pricing model:

- ▶ **Focus on Organic Returns:** The model focuses on understanding the organic returns realized by investors rather than returns reported by private sector companies.
- ▶ **Analyst-Curated Data:** The model leverages the deals of venture capital-backed companies that are similar to the subject company. These comparisons are curated by PitchBook industry analysts, who identify comparable companies based on deal type, location, product mix, industry vertical, and size of the company.
- ▶ **Transparency:** A private company's implied valuation must be easily traced back to its underlying source factors (past deals, private comparables, and public comparables) and their respective parameter weights on a daily basis.
- ▶ **Rapid Response to Market Events:** Our model must respond quickly to market environment changes. Public stocks often lead private valuations by several quarters, so the model must look to both the public and private market comparables and mark private company valuations up or down accordingly.
- ▶ **Multiple Calibrations on the Marks:** We continuously calibrate relevant data inputs such as public comparable companies and private deals. This ensures the model is relevant across time periods.
- ▶ **Model Governance:** The model and data infrastructure is actively monitored by a team of quantitative analysts. The model governance committee also periodically reviews the model and suggests changes as appropriate. The team of analysts is available to answer any client queries pertaining to the model.

Mark-to-Model Pricing Methodology

We start by focusing on "unicorns" — venture capital-backed private companies that have reached a post-money equity valuation of \$1 billion. The list includes 1,502 companies globally (as of March 2023) for building the pricing model. These companies either are or were unicorns.

Exhibit 2 Growth of Unicorns



Source: Morningstar.

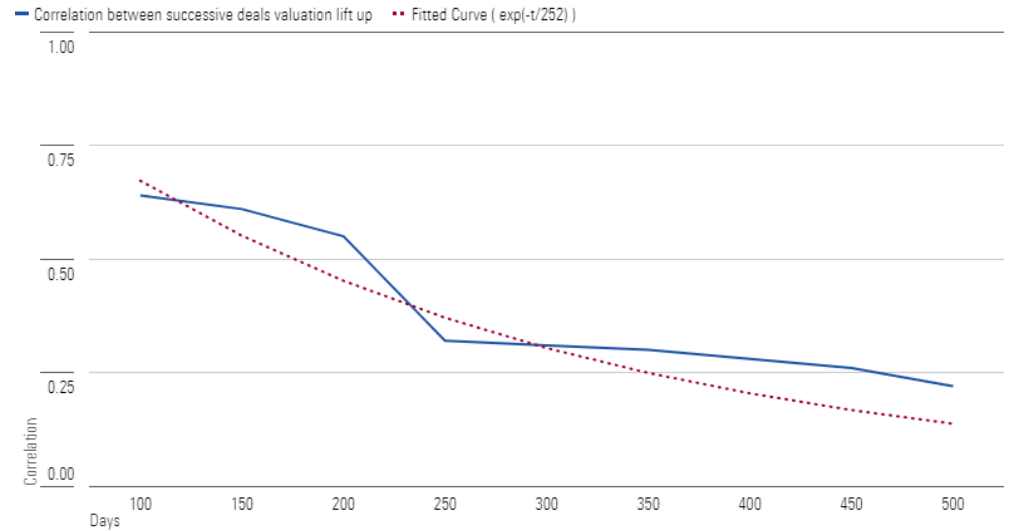
For our universe of private companies, we use past deal data, comparable private companies, and public market comparables to create an implied price. These time-series data enable estimation of daily valuations of private companies, which we can use to better understand their risk and return characteristics.

We now describe the rationale for using these factors in our model and elaborate on the model setup.

Past Deals Factor: The past deals factor is arguably the most important data point we use to value the unicorns, simply because it reflects real-world deals and valuations. When a private company raises money, we can infer an implied as-converted equity valuation for the company. If an investor valued a private company after this deal, this latest deal value would generally be the best estimate in the absence of any other data.

However, investors cannot rely solely on past deal data, especially if the deals happened long ago. The older a deal, the more "stale" or potentially irrelevant it becomes. PitchBook's venture capital data shows that, on average, there is a one-year gap between financing rounds for private companies. More specifically, there is an 18-month gap between successive deals for all unicorns. The scarcity of this data suggests that a decay of the past deal information is required for realism. Exhibit 3 demonstrates this aspect. As time elapses from the deal date, the ability of past deals' values to imply valuations of private companies in subsequent deals diminishes. Here the deal steps (up/down) refer to the jump in valuation of private companies in subsequent rounds.

Exhibit 3 Determining Decay Factor for Past Deals Using Subsequent Deal Steps Across Dates



Source: Morningstar.

We assessed data for more than 9,000 deals across roughly 2,500 private companies. For our mark-to-model method, we use the past deals data and decay the information exponentially ($\lambda = e^{-t/252}$) where t is the number of trading days since the most recent deals. The exponential function has been empirically determined by mathematically fitting an exponential function (red line) to the data points in Exhibit 3. The exponential function implies a half-life of six months, indicating the importance of past deals declines by 50%. An example of past deals factor creation for Revolut is shown in Exhibit 4.

Exhibit 4 Past Deals Factor Construction for Revolut

	Date	Pre-money Valuation	Deal Size	Post-money Valuation	Decay Factor	Past Deals Information Contribution
Deal happens →	7/24/2020	4768.94	562.19	5331.13	1.00	5331.13
	8/24/2020				0.91	4866.11
	9/24/2020				0.84	4459.30
	10/24/2020				0.77	4086.51
	11/24/2020				0.70	3744.88
	12/24/2020				0.65	3445.45
	1/24/2021				0.59	3169.97
	2/24/2021				0.54	2904.96
	3/24/2021				0.50	2662.11
	4/24/2021				0.46	2439.56
	5/24/2021				0.42	2235.61
	6/24/2021				0.38	2048.72
Deal happens →	7/15/2021	35578.04	807.08	36385.12	1.00	36385.12

Source: PitchBook.

Revolut had an initial deal on July 24, 2020, and the post-money valuation in millions reported on that date is \$5,331.13. As time passes, the deal value becomes less and less relevant. Applying the decay factor to the past deals, we arrive at the contribution of the past deal information to the value of the unicorn on each successive date. The values and weights were reset upon a new financing round on July 15, 2021.

Private Comparable Factor: Another important model input is private comparables, also known as M&A comps, or precedent deals of privately owned companies that are similar to the subject company. A private comps analysis considers recent private market deals involving similar companies. This is conceptually similar to real estate appraisals. The key to doing this well is picking the right comparable companies. PitchBook analysts identify several comparable companies based on variables like deal type, location, product mix, industry vertical, and size of company. Comparing private companies in a similar growth stage and industry adds more insight than public market comparables when the valuation data is available. The pool of comparable private companies provides more updated valuation information relative to the target company than company deal information alone.

We create our private comparable factor as follows:

1) PitchBook analysts supply a list of hand-chosen similar private companies. A sample company, Revolut, along with its comparable companies are displayed in Exhibit 5. The analysts also assign a comparability score, ranging from 1 (limited comparability) to 4 (high comparability) for each comparable.

Exhibit 5 Private Comparable FinTech Companies for Revolut

Comparable Company	Comparability Score
MoneyLion	4
Toss	2
Starling Bank	4
OakNorth Bank	4
Current	4
Monzo	4
Lunar	4
Greenlight Financial Technology	2
Varo	4
Dave	4
SoFi (Consumer Finance)	4
N26	4
Chime	4
Nubank	2

Source: PitchBook.

- 2) We extract the latest deal information for each private comparable company.
- 3) Deals are decayed, just like the past deals factor, based on the comparable deal date.
- 4) We sum these past deals, weighting by comparability score and the last known postdeal valuation of each private comparable. The latter is akin to market-cap weighting of information in public markets and allows us to reduce the impact of outliers.

This is illustrated in Exhibit 6, which demonstrates two comparable companies for Revolut. Each has two deals, allowing us to infer the return for each company. Based on the valuation after the deals, the comparable returns are negative 32.6% and 168.8%, respectively. Both companies have different values and comparability scores alongside different time frames for deals. We use both of these to create a comparability factor, which is a sum of deal returns weighted by comparability score, market value, and the decay parameter. Weighting ensures we increase weights on the most similar companies and those that happened closer to the date of evaluation. Finally, we consider that smaller companies tend to see significant jumps in valuations and such companies may tilt the factor heavily toward them. To nullify the effect, we also weight each deal by the last known postdeal valuation. This increases the relative influence of large deals.

Exhibit 6 Private Comparable Factor Construction for Revolut



Source: Morningstar.

Public Comparable Factor: This factor reflects the public market performance of the closest thematic index to a given unicorn. It results from public comps analysis—comparing public market thematic indexes with the unicorns and assigning each unicorn a thematic index of best fit. Respective Morningstar Thematic Indexes are used as baselines here. When a company touches multiple themes, Morningstar analysts match it to the theme that is most relevant. In contrast to private comps analysis, public comps analysis is generally easier to perform because public companies are required to publish a wide variety of information. While baselining to public thematic indexes, we use multiple criteria such as

sector, geographical location, revenue, and business lines. An example of equivalent thematic indexes for private companies is described in Exhibit 7.

The transition from mapping unicorns to GECS sectors and industries is one of the new features of the enhanced model and brings along significant advantages. Unicorns often operate at the intersection of multiple industries, making it difficult to confine them to a single sector. By mapping them to themes, such as fintech innovation or cryptocurrency, we can capture the essence of their transformative nature more accurately. Themes provide a broader perspective, allowing us to identify emerging trends and opportunities across different sectors. Unicorns are often at the forefront of these trends and mapping them to themes enables investors and analysts to better understand the underlying forces shaping the business landscape. Also, themes are more adaptable and flexible compared with rigid industry classifications, as they can evolve and encompass new developments. This approach encourages a dynamic approach to tracking and understanding the unicorn ecosystem, enabling better insights and informed decision-making in a rapidly changing business environment.

Exhibit 7 Public Comparable Example

Unicorn	Thematic Tag
Klarna	Fintech Innovation
Kraken	Cryptocurrency
Razorpay	Fintech Innovation
Revolut	Fintech Innovation
Udemy	E-Learning
Stripe	Fintech Innovation

Source: Morningstar, PitchBook.

We then create a public market factor based on the performance of the comparable public thematic indexes between the past deal date and valuation evaluation date. For an illustrative example, in Exhibit 8, we show a company deal for Revolut on July 24, 2020. Between deals, the public comparable index grew, growing the public comparable factor accordingly.

Exhibit 8 Public Comparable Factor for Revolut

	Date	Pre-money Valuation	Deal Size	Post-money Valuation	Public Market Growth Factor	Public Market Factor Value
Deal happens →	7/24/2020	4768.94	562.19	5331.13	1.00	5331.13
	8/24/2020				1.09	5787.01
	9/24/2020				1.03	5490.45
	10/24/2020				1.12	5970.87
	11/24/2020				1.18	6313.15
	12/24/2020				1.29	6874.66
	1/24/2021				1.36	7240.66
	2/24/2021				1.38	7349.41
	3/24/2021				1.31	6994.41
	4/24/2021				1.41	7504.26
	5/24/2021				1.36	7250.34

Source: Morningstar.

Risk Adjustment Factor (RAF)

While incorporating new public comps based on themes makes the model valuations more representative, they still lag the numbers during periods of extreme market volatilities. Based on several published artifacts, the increased volatility in public markets can affect private market valuations in several ways:

- ▶ **Reduced investor appetite for less liquid private market investments:** Investors exhibit higher risk-aversion during periods of market volatility and are usually unwilling to invest in the riskier and more-illiquid private markets.
- ▶ **Increase in the risk of private market investments:** Private companies are more likely to be affected by economic downturns and other market disruptions than public companies.
- ▶ **Denominator effect:** Public markets fall faster than private markets; as a result, the weight of public markets in an investor's overall portfolio diminishes, leaving a high net exposure to private markets.
- ▶ Private companies find it increasingly difficult to raise fresh capital during periods of high uncertainty in the public markets.

This justifies the use of a risk adjustment factor that accounts for the current risk sentiment of the public markets. As and when the risk sentiment increases, our valuation model needs to be able to increase the sensitivity of valuations to the public markets. Static weights assigned to public and private comparables may not accurately capture the dynamic nature of the market. The RAF dynamically adjusts the weights assigned to public and private comps based on market conditions. We use trailing three-month volatility as a measure of the market risk sentiment.

- ▶ On the valuation date, the trailing three-month return of public comps is calculated, and the median of historical rolling three-month returns over the past three years is determined.

- ▶ To assess the volatility of public comps relative to their historical median, a percentile score is derived by comparing the current three-month return to the historical three-month volatility.
- ▶ If the percentile rank exceeds 50, RAF is calculated, indicating the necessary adjustment for public comps.

This dynamic approach, facilitated by the RAF, ensures that the weights assigned to public and private comps are responsive to changing market conditions and reflect the evolving landscape over time. By incorporating and adjusting for volatility, the valuation models become more reliable and introduce a certain degree of volatility in the valuations that is usually missing in private company valuations.

Putting It All Together

The initial model development relied on these three factors to estimate the current valuation of each company. The model results were significantly affected by the factor weights. To this end, we used a numerical optimization routine as described below to initialize the model parameters. The optimization prioritized private market factors during up markets and public market factors during down markets. However, down rounds boosted the private comparable factor as private companies' valuations "catch up" to public markets.

Optimization Objective:

The optimization problem, used to calculate the three factor weights, is:

$$\min_{w_{pd}} \sum (PD_t - Estimated_Price_t)^2 \quad (1)$$

Subject to the constraints:

$$w_{p.d.} + w_{pu.r.} + w_{pv.r.} = 1 \quad (2)$$

$$w_{p.d.}, w_{pu.r.}, w_{pv.r.} \geq 0 \quad (3)$$

where:

$$Estimated_Price_t = (W_{pd} * \lambda_t + W_{pur,t} * R_{pur(t-1,t)} + W_{pvr,t} * R_{pvr(t-1,t)}) * PD_{t-1} \quad (4)$$

and:

W_{pd} = Weight of past deals as determined by the optimizer

$W_{pvr,t}$ = Weight of private market returns at time t

$W_{pur,t}$ = Weight of public market returns at time t

PD_{t-1} = Last Known Postdeal Valuation for the unicorn prior to t

λ_t = Exponential Decay factor demonstrating relevance of PD_{t-1} at time t

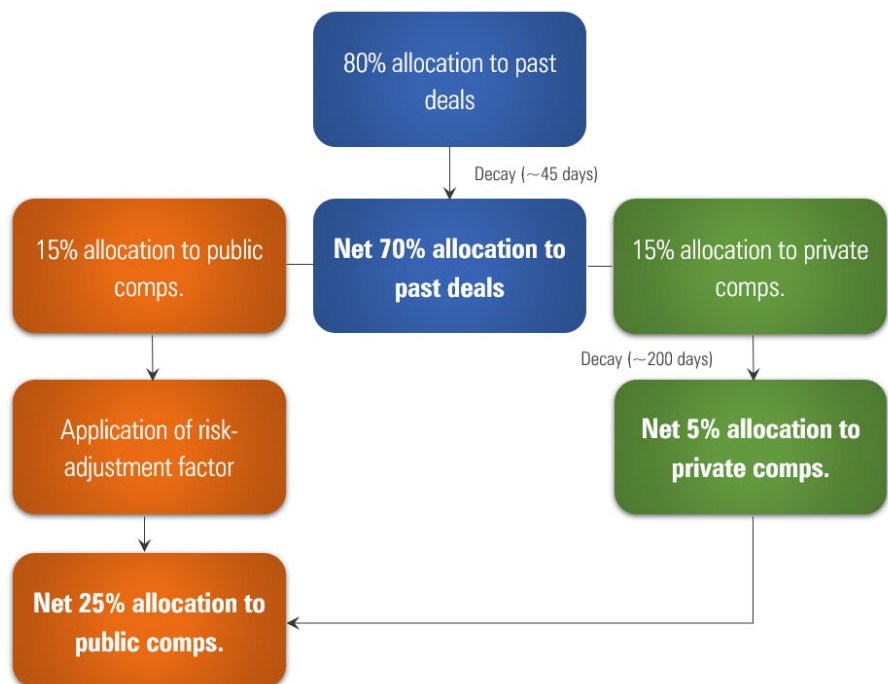
$R_{pvr(t-1,t)}$ = Private Comparable Factor between t and $t - 1$

$R_{pur(t-1,t)}$ = Public Comparable Factor between t and $t - 1$

The optimization model was executed on the private company data from January 2014 to the present. This comprises more than 9,000 deals. The optimization resulted in weights to be applied to past deals, public comparables, and private comparables for all constituents. Once relevant weights were determined, we populated the valuation series for all unicorns based on the formula for calculating the mark-to-model valuations as discussed above.

At a high level, our model relies on the past deals factor, when possible, but will fill in the gaps from private comparable deals and public comparable indexes. Exhibit 9 depicts the relative factor importance in estimating mark-to-model valuations for a sample company. We assume that the three-information factor source weights add up to one. On deal dates, we prioritize the post-money valuation as the best estimate of the worth of the private company. As time passes, the relative weighting to past deals is decayed (70% as per Exhibit 9), and we increase priority of private and public comparables. We initially allocate the remaining weights (30%) equally between the factors, and we then rely on the performance of the public market (relevant thematic index). At the same time, we also introduce the risk adjustment factor to establish the final weight to the public comparable factor. As discussed on the section on RAF, based on the risk sentiment, we linearly increase the allocated weight to the public comparable factor. Next, the remainder weight is allocated to the private comparable factor. Since private comparable deals may have happened at a lag of several days from the evaluation date, we need to decay this factor as well. The weight of private comparable gets reduced subsequently. The weight that gets reduced from the private comparable factor subsequently gets added to the public comparable factor to give us the final allocations.

Exhibit 9 Price-Information Waterfall



Source: Morningstar.

Key Considerations for Mark-to-Model Pricing

Our model makes several assumptions, outlined below. As we consume additional data and information, we anticipate the need to update our assumptions and our model to best reflect realized valuations.

1) PitchBook analysts provide comparable companies for private companies, which are available for approximately 35% of the eligible 1,502 unicorns. In the absence of private comparable, we reallocate the weight to public comparable. In such cases, the RAF plays no role.

2) Our private and public comparable data is only available going forward. We assume our initial mappings are consistent historically, which may be less than ideal and potentially introduces some look-ahead bias. To the extent that business models or goals have radically changed, some comparables may be a poor fit for some historical periods. As we support this dataset over time, we would expect accuracy to improve.

3) During visible down rounds of private comparable companies, the private comparables factor gets relatively more weight than public comparables. We believe private comparable information is more relevant during such periods.

4) Public markets trade 252 days of the year, but private deals can occur over weekends. We assume that private deals occur only when public markets are in business. Any deals that happen on nonbusiness days are brought into effect on the next business day.

5) When a company raises new money, it issues new shares to these new shareholders, and consequently, the existing investors undergo a stake dilution. As mentioned earlier, we intend for the valuation levels to be indicative of realized investor returns. To that end, we adjust the estimated valuation on the day a new deal happens. Accordingly, we transform the final valuation levels on such days based on the returns between the previous day's valuation and the deal date's pre-money valuation.

6) The decay function has been empirically determined to be exponential based on distribution of the deals data.

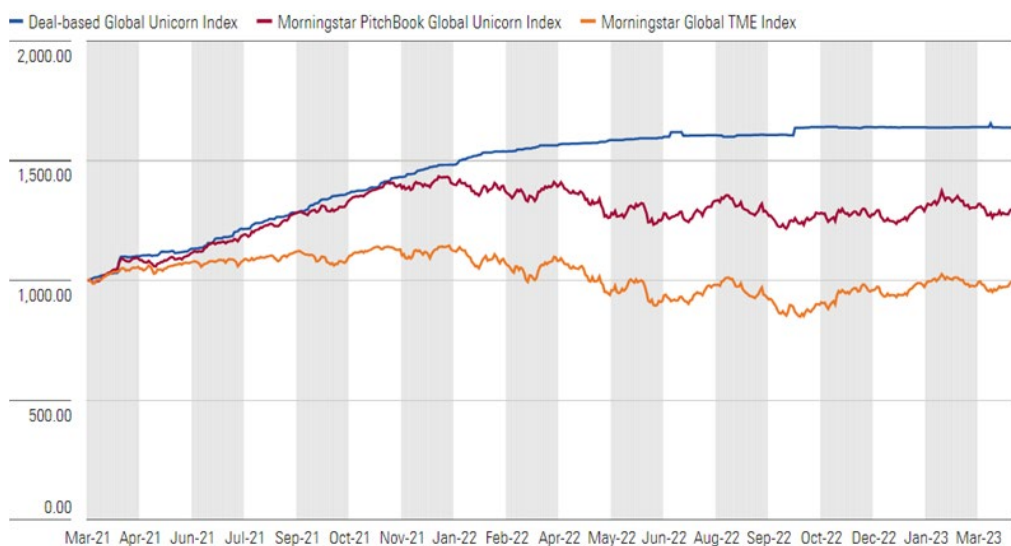
Discussion of Results

After robust testing, the optimized weights on public, private, and past deals were in the range of 10%, 10%, and 80%, respectively. While testing has been thorough and factor weights are established, we expect to reoptimize and revise weights periodically in a tightly governed process. Based on the pricing equation shown in this paper, we can estimate the daily value of private companies. We use these valuations to calculate the Morningstar Pitchbook Global Unicorn Index levels at an aggregate level.

Exhibit 10 shows the historical Global Unicorn Index levels. To assess the efficacy of our approach, we can compare the mark-to-model index levels (blue line) to the index levels using only past-deal values (red line). The red return series is purely deal-weighted, with postdeal values input to the latest date. As

shown, the series has very low volatility, while the mark-to-model return series exhibits higher volatility. The mark-to-model captures market events such as the early 2022 stock market downturn driven by higher inflation and rising interest rates. The divergence away from the past deals-based index can also be explained by the fact that deals in private markets dry out during bear markets.

Exhibit 10 Morningstar Pitchbook Global Unicorn Index Historical Prices (March 2021-March 2023)



Source: Morningstar.

Exhibit 11 demonstrates the backtested summary for the newly created return series using mark-to-model estimates. Public markets have been rather volatile since the beginning of 2022. The introduction of RAF and thematic indexes has made our model sensitive to the public markets during periods of high volatility.

Exhibit 11 Global Unicorn Index Return: Mark-to-Model vs. Past Deals (March 2021-March 2023)

Model	Mark-to-Model (%)	Past Deals Based (%)	Public Market Benchmark (%)
Total Return (Cumulative)	29.87%	63.76%	-0.44%
Total Return (Annualized)	13.74%	27.50%	-0.21%
Volatility (Annualized)	12.06%	4.80%	15.44%
Maximum Drawdown	-15.19%	-1.26%	-25.88%

We also perform efficacy testing of the model to identify changes in unicorn valuations. To this end, we place the available unicorn deals data between January 2021 and March 2023 into two valuation buckets: major up rounds (increase in valuations of subsequent rounds of more than 5%) and major down rounds (decrease in valuations in subsequent rounds of more than 5%). We then measure the ability of the model to identify the valuation changes of underlying deals in either of these buckets

aggregated across all deals. An efficient model should be able to correctly identify actual up rounds and down rounds.

The results are displayed in the form of a contingency table or confusion matrix in Exhibit 12. The model was able to identify 77% of major up rounds and 84% of major down rounds when aggregated across all deals. The model misclassified 23% of actual up rounds as down rounds and 16% of down rounds as up rounds. Overall, the model correctly identified 78% of up and down rounds.

Exhibit 12 Model Ability to Identify Major Up/Down Rounds

		Actual Return	
		Positive	Negative
Predicted Return	Positive	77%	16%
	Negative	23%	84%

Source: Morningstar.

Challenges and Limitations of the Mark-to-Model Pricing Methodology

Estimating asset valuations in the absence of public, liquid markets is challenging. Earlier asset-pricing models have several drawbacks. Some limitations of our mark-to-model pricing methodology are:

- 1) The methodology considers only company-sponsored financing rounds and does not consider secondary transactions in company securities.
- 2) The methodology calculates implied subject company transaction value on an as-converted basis, which ignores liquidation preferences and other security rights and privileges.
- 3) The methodology calculates implied subject company transaction value without considering all stock options.
- 4) The methodology utilizes the most recent subject company deal and assumes the deal represents fair value. There may be circumstances where the deals are not indicative of fair value.
- 5) The valuation methodology discussed in this paper is intended to be used to capture the pulse of broader private markets tracked through a basket of securities or indexes. To this end, the methodology outcomes should be treated cautiously for valuing individual private companies.

6) Private markets' observed returns are smoother (because of a lack of observable transactions), often leading to serial correlation and a lower level of reported volatility. As part of our methodology, we have relied on public and private comparable data to de-smoothen the return series. To this end, our Private Market Index series may still have some serial correlation, which may be a subject of future research.

7) Many thematic indexes have been launched only after or during 2021. The model is bound to use thematic indexes as and when they become available. For valuations of unicorns during periods before their respective thematic index was launched, we still must use the GECS industry mapping as we did in version 1.

Conclusion

Private markets are a growing and important component of the investing landscape. They provide investors with the opportunity to gain exposure to companies that are not accessible in public markets and the potential to generate excess returns compared with public investments or to lower the risk of an overall portfolio.

But valuing a private company is an inexact exercise. As there is no liquid market for most private companies, it is difficult to determine what an investor would pay for them at any point in time. There are also challenges around the availability of quality, timely data. Given the nature of the data for private companies, no model can capture all idiosyncratic risks for each company.

Our model overcomes some of the challenges of private markets by combining multiple data sources in a dynamic way to better estimate valuations. The model leverages the high-quality data on private companies and deals from PitchBook alongside public and private comparables that are curated by a team of PitchBook analysts and Morningstar researchers. When data on past deals is limited, we allocate more weight to public markets. The key tenets of the model are a focus on realized investor returns, transparency, objectivity, and the use of all relevant data to reach conclusions.

New-age thematic indexes offer a lucrative alternative to traditional industry indexes as a map for unicorns to a public market. They better represent the performance of the broad public market vertical that a unicorn can be best tied to. The RAF makes the model more sensitive to the public markets during periods of high volatility. These two things together ensure that the valuations generated are a relatively closer reflection of the valuations reflected in the secondary markets.

While the model provides some pricing information at the company level, the valuation of any given company will always be uncertain. We believe our pricing model provides a robust way to track trends in aggregate valuations across companies over time. The output of the model can be used to create private market indexes, which are relatively less noisy as compared with valuations of individual companies. These indexes will enable investors to better understand trends in private markets and will help reduce the information gap between private and public markets. Additionally, we believe the introduction of

this index family will offer wealth advisors and other asset allocators improved tools to make appropriate portfolio construction trade-offs for their clients.

We expect that the model will evolve with the availability of improved data sources. As the model evolves, we will produce explanatory notes supporting the changes.

Appendix

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