Partner Perspectives

Unlocking Potential Ahead with **S&P Global** and **Vanguard**

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Fifty years ago, a single innovation transformed investing forever. The launch of the first index mutual fund marked the beginning of an investing revolution, broadening access to public markets and reshaping financial possibilities for millions.

We now stand at a similar inflection point. The forces shaping global capital markets are profound: Tokenization and the rapid expansion of exchange-traded funds, particularly in the fixed income market, are transforming how assets are created and traded; private markets are expanding and opening new avenues for growth; shifting bond markets are offering the promise of greater efficiency and flexibility; and AI is redefining how risk is assessed and how capital flows. These developments are not incremental; they represent a systemic shift toward an even more data-driven and dynamic financial markets ecosystem.

Progress is rarely the work of one institution or perspective. As we look ahead, adaptation and cooperation are critical. Progress will be determined by working together — across sectors and borders — to shape infrastructure and policies, and to source and showcase the essential intelligence that will unlock opportunities for everyone.

I am proud to introduce our new series from the Look Forward Council, "Partner Perspectives: Unlocking Potential Ahead." The first volume features a collaboration between S&P Global and Vanguard. The combined expertise of our institutions delivers crucial insights, investment ideas and clarity in a complex world. *Together,* we help you understand the investment landscape and put that knowledge into action. *Together,* we have the power to shape a more rewarding future.

Thanks for reading.

Martina

Martina Cheung
President and CEO, S&P Global

Contents

In the shadows of giants

Navigating the long-term dynamics of performance and concentration in US equities

By Timothy Edwards, Global Head of Index Investment Strategy, S&P Dow Jones Indices

Highlights

The 10 largest companies in the S&P 500 represented almost 40% of the index by mid-2025, a level of concentration not seen since the mid-1960s.

While the past does not guarantee the future, we can gain perspective by examining what happened last time 10 companies held a similar index weight.

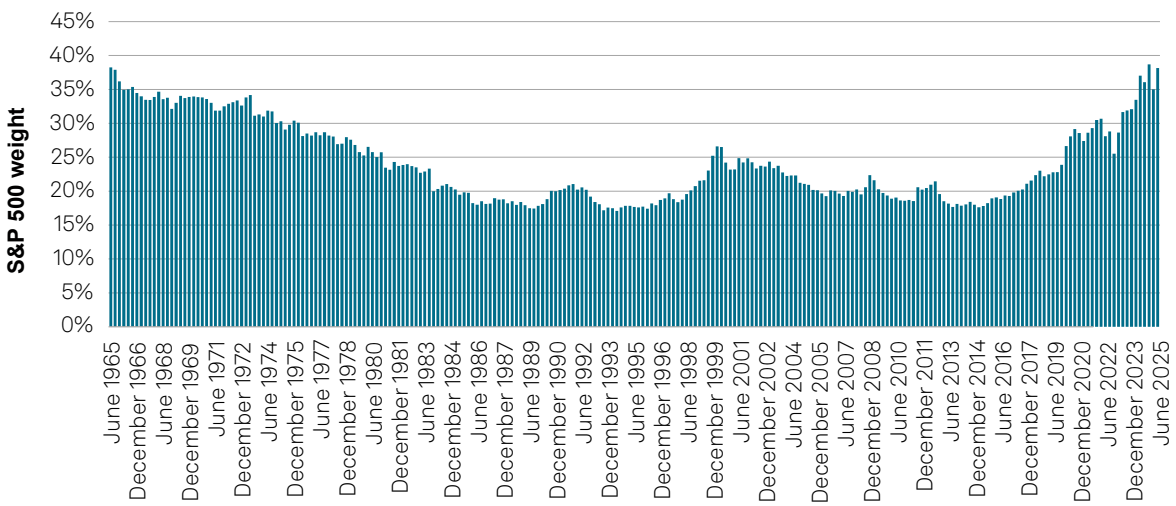
History shows a nuanced relationship between concentration and market performance and illustrates how changes in leadership can impact markets and their benchmarks.

The concentration of US equity market capitalization in a select few mega-cap companies has reached levels not seen for more than half a century due to unprecedented investment in rapidly advancing and highly disruptive technologies. The potential risks and opportunities resulting from this market concentration may find parallels in historical trends, the examination of which offers insight into the continued relevance of broad, capitalization-weighted benchmarks such as the S&P 500®.

More than 12 years ago, CNBC's "Mad Money" host Jim Cramer helped popularize the acronym "FANGs" for a select group of high-growth, technology-driven stocks that dominated their market segment. Other market participants and commentators subsequently observed and grew concerned about the narrow leadership within US equity markets. The monikers and composition have evolved, but the overall outperformance by the largest US companies was almost unchallenged throughout, and the distribution of market capitalization in the US equity market became increasingly concentrated as a result. By mid-2025, the largest 10 companies in the S&P 500 represented almost 40% of the index, a level of concentration not seen since the mid-1960s.

Top 10 weights as a proportion of the S&P 500

Quarterly data from June 1965 to June 2025

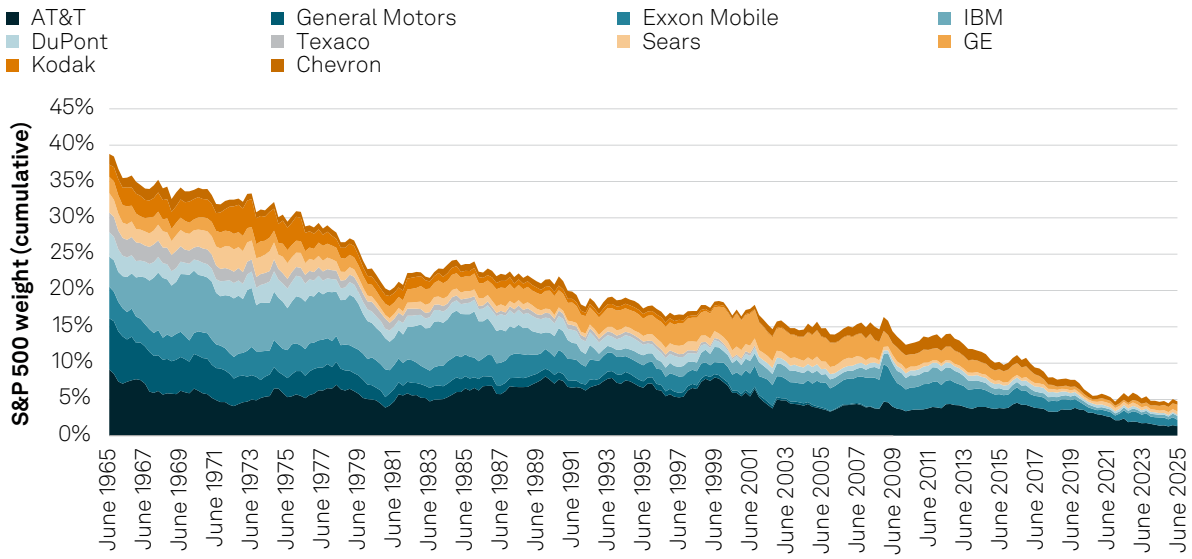


Data as of June 30, 2025.
Shows the weight of the then-current 10 largest companies.
Source: S&P Dow Jones Indices LLC.

Market participants are now considering the implications of this concentration. Does it represent a systemic risk for overall markets? Is a market-capitalization-weighted approach to investing (or benchmarking) still appropriate? What might happen if the current AI-fueled enthusiasm proves valuations are too optimistic? The past does not guarantee the future, but we can gain perspective by examining what happened last time 10 companies held a similar index weight.

The following chart illustrates the individual and cumulative weights of the earliest cohort of "top 10" companies, both as they were initially on June 30, 1965, and as they evolved over the following 60 years. To create the second chart, we included the subsequent weights of spinoffs and demergers from the initial 10 companies, including AT&T's dissolution into a multitude of "Baby Bells," for example. Weights following mergers were continued at pro rata proportions according to each merger's terms and conditions.[1] The aggregate performance of the June 1965 top 10 cohort was underwhelming. Three entered bankruptcy proceedings, all fell to represent much smaller weights, and several represent potential business school case studies in "what went wrong" with once widely admired and dominant US corporations.

June 1965 S&P 500 top 10 cohort subsequent weights



Data as of June 30, 2025.
Shows the weight of the then-current 10 largest companies.
Source: S&P Dow Jones Indices LLC.

1 This exercise required a somewhat manual and discretionary approach. Overall, the weights of 35 different companies are represented as the successors or progeny of the original 10, with S&P Dow Jones Indices' proprietary data complemented by public news sources and official records where necessary to determine which later companies represented the appropriate continuations.

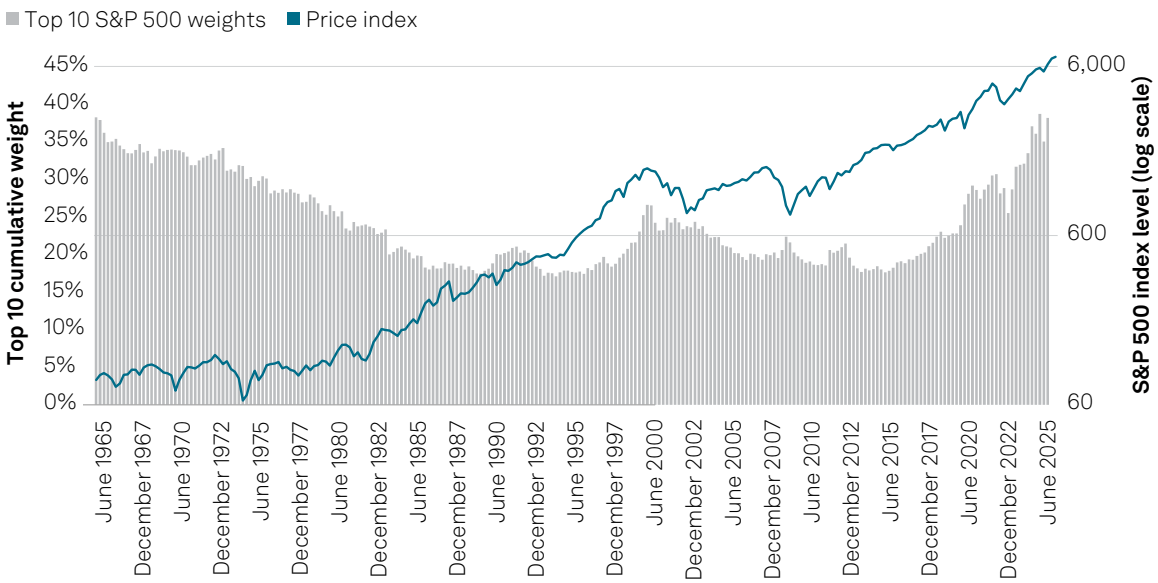
Summary statistics – June 1965 S&P 500 top 10 cohort

Company	June 1965 weight	Max subsequent weight	June 2025 weight	Exit from S&P 500 (if applicable)
AT&T	9.11%	9.11%	0.00%	Nov. 5
General Motors	7.06%	7.23%	0.00%	June 9
Standard Oil Co. of New Jersey (Exxon)	4.36%	5.41%	0.88%	Still a member
IBM	4.15%	9.04%	0.52%	Still a member
DuPont	2.80%	2.80%	0.05%	Still a member
Texaco Inc.	2.71%	2.74%	0.00%	Merged with Chevron
Sears, Roebuck & Co.	2.68%	3.14%	0.00%	Sept. 12
General Electric	2.24%	4.53%	0.52%	Spinoff member
Eastman Kodak	1.66%	3.88%	0.00%	Dec. 10
Gulf Oil Corp. (Chevron)	1.47%	2.07%	0.44%	Still a member
Average	**3.82%**	**4.99%**	**0.24%**	**54 of 60 years in**

Data as of June 30, 2025.
Max weight based on quarter-end data.
Source: S&P Dow Jones Indices LLC.

These companies represented almost half of the index at the starting point, and many remained in the index, performing poorly over the next 60 years. It might seem likely, therefore, that the subsequent performance of the S&P 500 would also be disappointing. However, the opposite was true — albeit after a rocky start.

S&P 500 performance, June 1965 to June 2025



Data as of June 30, 2025.
S&P 500 price performance in US dollars, excluding dividends, shown in logarithmic scale (right axis).
Past performance is no guarantee of future performance.
Source: S&P Dow Jones Indices LLC.

Returns and concentration changes by decade – June 1965 to June 2025

Period	Annualized S&P 500 price return	Change in top 10 weights over period
June 1965–June 1975	1.17%	-9.16%
June 1975–June 1985	10.84%	-9.61%
June 1985–June 1995	12.53%	-1.80%
June 1995–June 2005	10.00%	3.25%
June 2005–June 2015	5.46%	-3.11%
June 2015–June 2025	11.66%	20.34%
Full period	**7.42%**	**-0.09%**

Data as of June 30, 2025.
Index performance based on price return in US dollars (i.e., excluding dividends).
Past performance is no guarantee of future results.
Source: S&P Dow Jones Indices LLC.

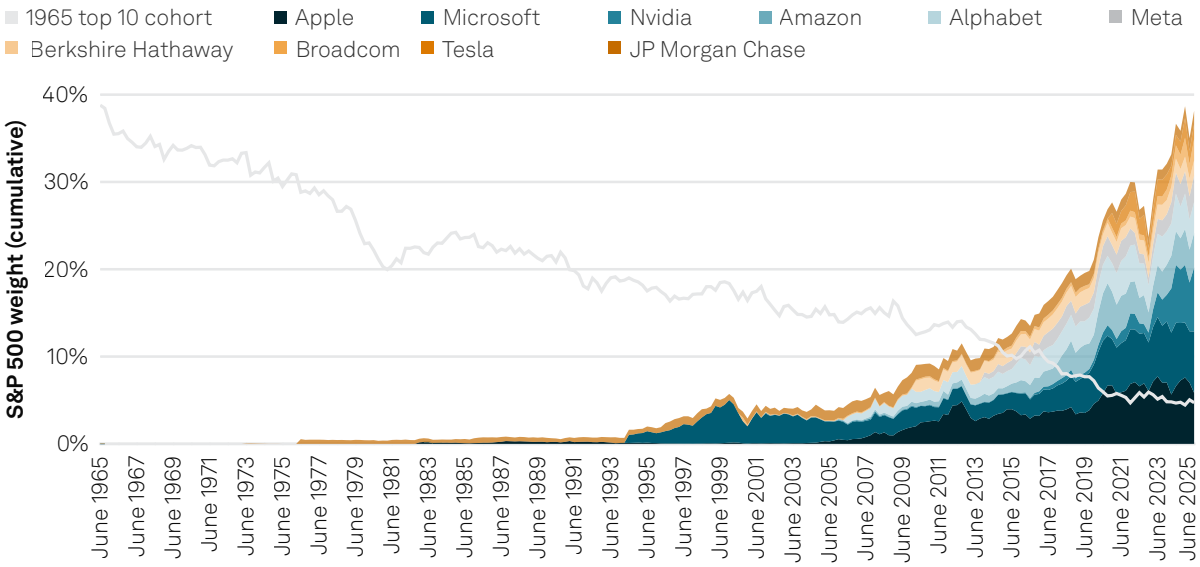
Overall, there is a mildly positive statistical correlation between changes in concentration levels and index performance, and this is particularly evident during two periods: the late 1990s and the early 2020s, when both concentration and prices surged. There are also periods when these moved in opposite directions, both in the short term and over the course of decades.

Changes in concentration can occur in various ways, indicating that the relationship between concentration and market performance is quite subtle. Concentration will decrease if the largest stocks perform relatively poorly, and it can also decrease when smaller index constituents perform unusually well. Both may happen at the same time, or neither. Over longer periods, a changing of the guard among the cohort of the largest companies may initially be associated with a decrease in concentration (as the old guard falters to lower rankings), followed by an increase in concentration as the new entrants expand their footprint at the top.

The following chart shows the rise of the "June 2025 top 10" cohort (the 10 companies with the largest weights in the S&P 500 by the 2025 calendar midpoint) over the same six-decade period that we examined earlier. We use corporate predecessors, where appropriate, to represent the initial form of the included companies.[2] Even including predecessors, none of the 10 were index members at the start; their entry times and weights are shown in the following table. The average constituent joined the S&P 500 around a quarter of a century ago, with an average starting weight of 0.58% and an average maximum subsequent weight of 4.37% — a more than sevenfold increase. Simple arithmetic confirms that this means each constituent's growth in market capitalization was many multiples of the market's return during their tenure.

2 To offer a few illustrative examples, Meta's initial weight is represented by what was then known as Facebook; we show the combined weights of both Chase Manhattan Bank and JP Morgan & Co. prior to their combination as JPMorgan Chase, and we include both share classes of Alphabet (formerly Google) from the point they were both included in the S&P 500.

June 2025 S&P 500 top 10 cohort prior weights



Data as of June 30, 2025.
See Figure 1 for the 1965 top 10 cohort, included here for purposes of comparison.
Source: S&P Dow Jones Indices LLC.

Summary statistics – June 2025 S&P 500 top 10 cohort

Company	S&P 500 entry date	Starting weight	Maximum weight	Length of time in S&P 500 (to June 2025)
JP Morgan Chase	June 1973	0.04%	1.9%	52 years
Nvidia	November 2001	0.07%	7.3%	24 years
Amazon	November 2005	0.13%	5.0%	20 years
Apple	November 1982	0.18%	7.7%	43 years
Broadcom	July 2000	0.37%	2.5%	25 years
Meta	December 2013	0.58%	3.1%	12 years
Alphabet	April 2006	0.67%	4.4%	19 years
Microsoft	June 1994	0.94%	7.3%	31 years
Berkshire Hathaway	February 2010	1.28%	2.1%	15 years
Tesla	December 2020	1.58%	2.4%	5 years
Average	**January 2001**	**0.58%**	**4.37%**	**24 years**

Data as of June 30, 2025.
Max weight based on quarter-end data.
Source: S&P Dow Jones Indices LLC.

To emphasize the point, the overall S&P 500 was not excessively affected by its underperforming heavyweights, because it included about 490 other companies. A rare select few among these delivered truly exceptional returns, which drove the entire market higher. In approximate terms, just 10 of them are responsible for one-third of the market's subsequent overall growth.[3]

This gives an important perspective on the merits (or demerits) of weighting benchmarks or investments according to market capitalization. At first glance, capitalization weighting may seem disadvantaged; the long-term history of capital and stock markets suggests that the current leaders will eventually face challengers. At least statistically, today's cohort of the very largest companies is unlikely to represent the very best-performing stocks of the future. If they do flounder, their weights in the benchmark will naturally decline. Future leaders may already be included among the relative minnows in the index, in which case, a capitalization-weighted approach ensures both initial participation in their gains and a future weight that grows in proportion to their relative outperformance.[4]

An adaptive approach to ride waves of change

Markets, and the benchmarks that measure and reflect them, are anything but static. They evolve in response to shifting economic landscapes, technological advancements and investor preferences. Those with a crystal ball may be able to achieve extraordinary returns if they can identify the next generation of giants. Yet most of us are absent such foresight; it may prove wiser to ride the waves of change than to position for a perfect storm. As illustrated, a broad-based, capitalization-weighted approach may continue to offer an efficient way to evolve and adapt with the emerging contenders as they compete to become the next titans.

Next up: Learn more about how investors combine index funds, the building blocks for portfolio construction, to achieve outcomes that meet their unique risk profiles and convictions, and how even greater diversification is just around the corner.

3 This approximation ignores stock issuances, buybacks, dividends, the impact of other index adds and drops, and several other factors, but it is an informative heuristic; if those companies entered at weights that summed to about 6%, and they now represent 40% of the total market cap of the index, then they were approximately responsible for adding the difference (i.e., 34%) of the total.

4 It is perhaps worth pointing out that although other changes may be necessary, maintaining market capitalization weightings does not require turnover to achieve these increases and decreases in weights — they simply rise and fall in proportion to the associated price changes among constituents.

Benefits beyond beta: Charting the evolution of index fund investing

Indexing has grown from a single strategy choice to offering diverse strategies for more tailored portfolios

James J. Rowley, Jr., CFA, Vanguard Global Head of Investment Implementation Research
Ollie Ryder-Green, Vanguard Investment Strategy Analyst

Highlights

Index fund investing has evolved from tracking a single benchmark — the S&P 500 — to a wide array of strategies, reflecting a growing emphasis on investor choice.

Because funds with similar labels can differ significantly in terms of composition, understanding the characteristics of the index a fund tracks is key.

The future of index fund investing lies in even greater differentiation via innovations such as direct indexing, strategy-specific overlays and tax-smart strategies that will continue to redefine what "index fund investing" means.

Fifty years ago, Vanguard launched the first index mutual fund, offering investors unprecedented access to the Standard & Poor's 500 Index. Since then, index fund investing has expanded to include strategies targeting specific sectors, styles, market capitalization segments, factors and regions. The shift from a single-fund strategy to index-based building blocks reflects a growing emphasis on investor choice, low-cost implementation and the integration of "passive" tools into actively oriented portfolios.

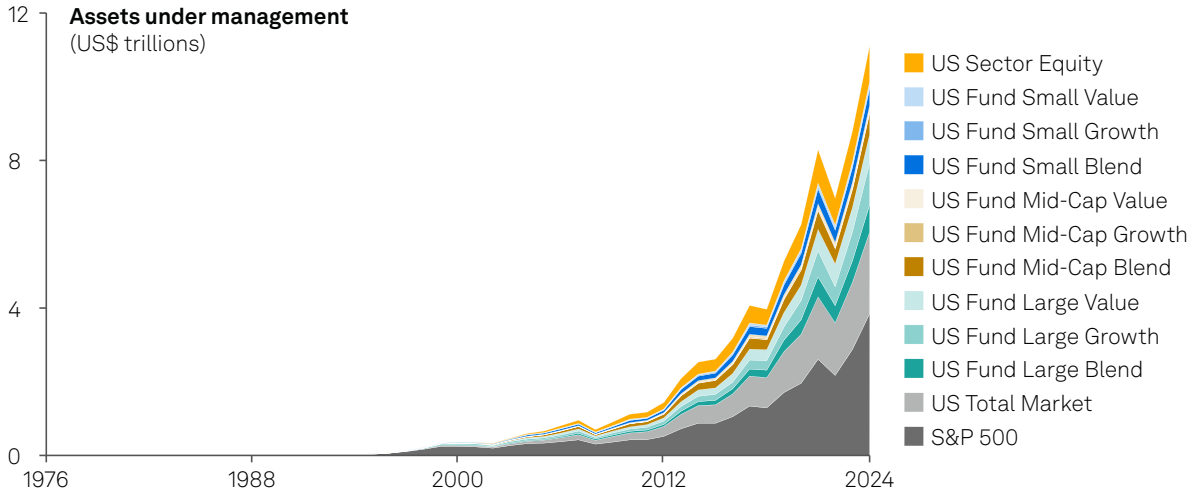
Index strategies: From monolith to mosaic

When index mutual fund investing started, there was only one game in town: the S&P 500 Index. For a long time after that, index fund investing was virtually synonymous with tracking "America's index," anchoring millions of portfolios to the benefits of broad diversification, cost efficiency and precision.

But as markets have matured and investor preferences have shifted, indexing has grown to encompass thousands of benchmarks with distinct security compositions.

Index fund strategies today offer a mosaic of choices. The chart that follows illustrates that while the S&P 500 continues to represent a significant proportion of US equity index fund assets, non-S&P 500 strategies have been capturing share. Beyond that, large-cap strategies now share the stage with indexes tracking various sizes, styles and sectors. This expansion of index strategies enables more precise portfolio construction aligned with investor goals.

In index fund investing, no single strategy prevails



The chart depicts the total US assets in US dollars of US-domiciled equity index mutual funds and exchange-traded funds annually from Dec. 31, 1976, to Dec. 31, 2024. Funds are grouped into 12 mutually exclusive categories. The US Total Market category comprises any fund whose primary prospectus benchmark is a total market index, such as the Russell 3000 Index or Wilshire 5000 Index, or any fund that otherwise indicates total market coverage in its fund legal name or prospectus. Funds not in the US Total Market category are US nontotal market funds and comprise the remaining 11 categories. The S&P 500 category comprises any US nontotal market fund whose primary prospectus benchmark is the S&P 500 Index or any fund that otherwise indicates it tracks the S&P 500 Index in its fund legal name or prospectus. Any US nontotal market fund that does not track the S&P 500 Index is categorized according to its Morningstar US category group: Sector equity funds are categorized as US Sector Equity and US equity funds are categorized according to their Morningstar category as one of US Fund Small Value, US Fund Small Growth, US Fund Small Blend, US Fund Mid-Cap Value, US Fund Mid-Cap Growth, US Fund Mid-Cap Blend, US Fund Large Value, US Fund Large Growth or US Fund Large Blend.
Sources: Vanguard calculations, using data from Morningstar and FactSet as of Dec. 31, 2024.

Index labels: What's in a name?

US "total market" indexes tend to be similar. However, when index providers carve up the total market, they can use very different methodologies, resulting in differentiated exposures for similarly labeled categories.

Even within index fund categories, each provider has its own distinct approach to benchmark construction. Methodological decisions determined by each benchmark provider — such as size segmentation, growth or value classification, and rebalancing cadences — can significantly affect portfolio composition.

Consider these distinctions:

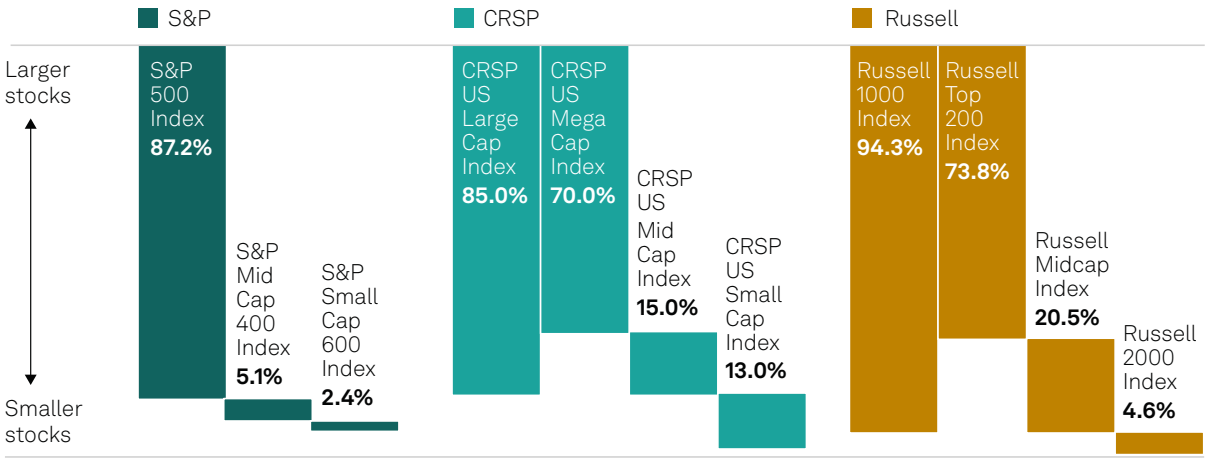
- **Size segmentation:** There is no single standard among index providers. Some providers segment size based on the number of constituents, while others do so on cumulative market capitalization.
- **Growth/value classification:** This also varies by index provider. Not only do providers consider different variables to determine growth or value — which can include earnings growth, price-to-book ratio and dividend yield — but they also use those variables differently to decide which stocks and how much of their market capitalization to designate as growth or value.
- **Rebalancing cadence:** While some indexes rebalance quarterly, others rebalance semiannually. The rebalancing methods seek to balance maintaining an index that reflects the relevant market exposure with taking into account real-world transaction costs.

These differences matter. For instance, the count-based methodologies of S&P and Russell yield different numbers of stocks and different proportions of market capitalization in their indexes. CRSP's market-cap-based methodology tends to result in a larger-cap bias, as illustrated by its weighted-average market capitalization of about $38 billion in its midcap index and $9 billion in its small-cap index, each greater than those in the offerings from Russell and S&P.

Choosing an index fund is not just about picking a label — the process begins by understanding the characteristics of the index it tracks.

How indexes stack up by number of holdings and market cap

Percentage of total US market capitalization coverage



Stock count	503	401	602	489	197	316	1,363	1,007	199	808	1,966
Weighted-average market cap	$1.12T	$9.7B	$3.4B	$1.11T	$1.32T	$38.4B	$9.1B	$1.01T	$1.29T	$28.6B	$3.6B

All index characteristics data as of Dec. 31, 2024. CRSP percentages represent methodology targets.
Sources: Vanguard, using data from S&P Dow Jones, FTSE Russell and CRSP.

The next chapter: Greater differentiation

In practice, investors routinely combine index funds — across sectors, styles, factors and regions — to achieve targeted outcomes aligned with their unique risk profiles and convictions at the aggregated portfolio level. These strategies have become building blocks for active portfolio construction.

The future of index fund investing lies in even greater differentiation. Direct indexing, strategy-specific overlays and tax-smart strategies are just a few of the innovations that will continue to redefine what "index fund investing" means. Investors will increasingly pursue their goals by constructing balanced, low-cost portfolios built on index funds — without losing the diversification and affordability that made index fund investing revolutionary in the first place.

Notes:

All investing is subject to risk, including the possible loss of the money you invest.

Diversification does not ensure a profit or protect against a loss.

Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

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Find out more: Take a deep dive into the world of fixed income index funds. We will consider the market's response to recent periods of turbulence, the anticipated impact of digitalization and what the future could hold for the sector.

Shifting bond markets: Resilience amid fragmentation

Supply and demand momentum contend with a more fractured world

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Highlights

Issuers have adapted to the end of the zero-policy interest rate era, supported by resilient economies and profitability, despite the uneven impact of tariffs.

The tech sector, especially expectations around the transformative potential of AI, drives a large share of market buoyancy. The development of domestic bond markets in emerging markets adds further support.

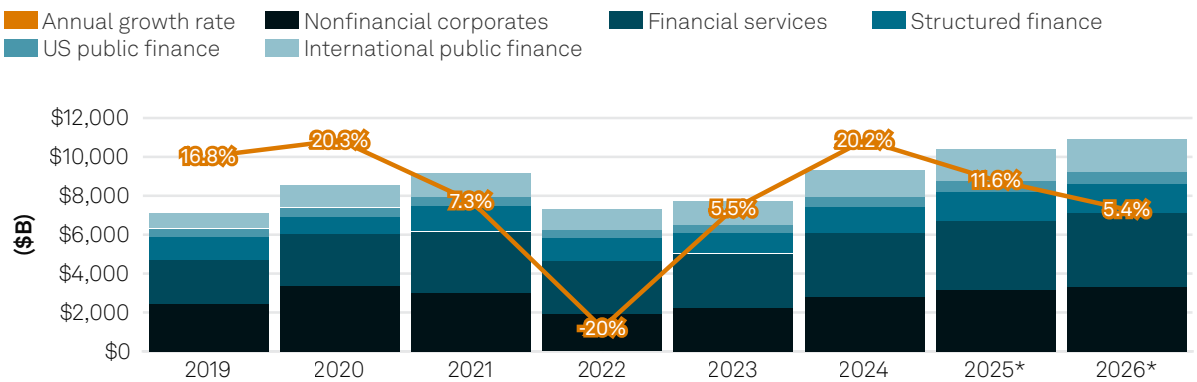
Innovations in bond markets infrastructure and the development of fixed income exchange-traded funds also support longer-term market prospects.

Global bond markets have adapted since zero-policy rates ended in key central banks. Supply and demand are robust despite heightened policy uncertainty and a more fragmented geopolitical landscape. Early signs point to ongoing resilience, even as long-term implications emerge. The digitalization of financial markets promises greater fluidity in capital movements, but progress will be nonlinear. The rapid growth of ETFs is adding a new layer of liquidity, further transforming the dynamics of bond investing.

Bond markets settle back into nonzero rate reality

Bond market issuance has proven resilient to the end of the zero-policy interest rate era in some key economies. Despite a short-lived slump due to a spike in US trade policy volatility, market appetite for debt in 2025 remained strong and should fuel issuance growth of 12%, following a 20% increase in 2024. Our base case assumes continued issuance growth normalizing to roughly 5% in 2026.

Historic global issuance and forecast



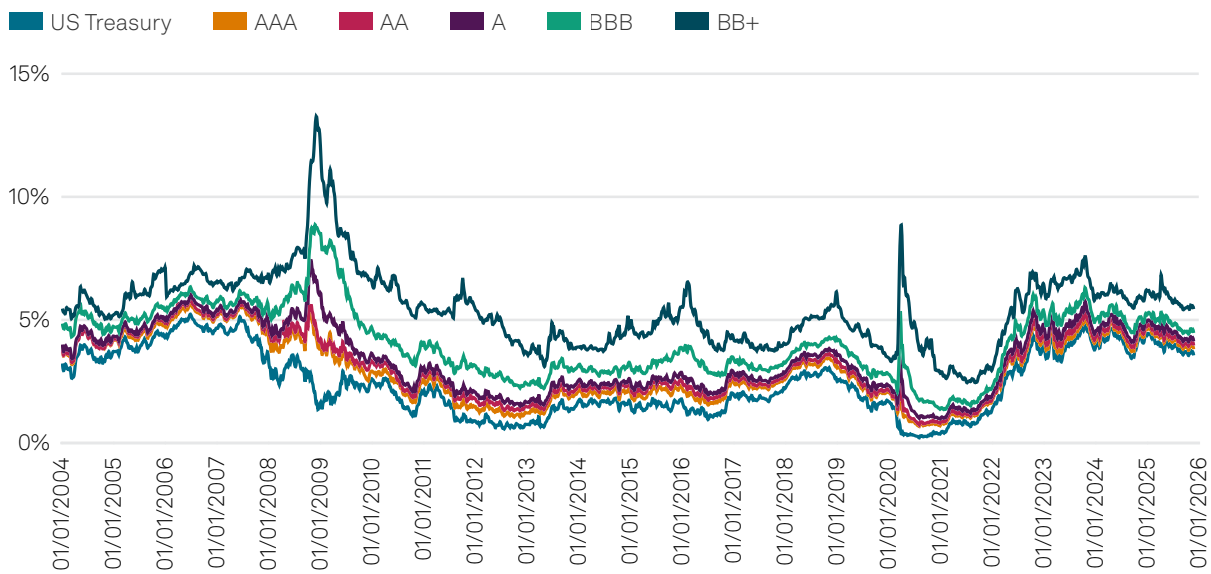
Data as of October 2025.
* Full-year forecast.
Structured finance excludes transactions that were fully retained by the originator, domestically rated Chinese issuance, and resets and refinancings of collateralized loan obligations.
Sources: Dealogic; Refinitiv; S&P Global Ratings Credit Research & Insights.

Tight spreads hide higher overall funding costs due to elevated benchmark yields

Corporate yields are above the past-20-year average, despite tightening spreads, due to higher benchmark government bond yields. These yields reflect robust sovereign debt supply, as many countries face mounting fiscal pressures from increased defence spending, infrastructure investments and social programs. Past yields were arguably reduced by the extended period of near-zero policy rates in some key central banks following the Global Financial Crisis. We do not expect a return to that in the foreseeable future, with the federal funds rate staying above 3% in our latest forecast, and the 10-year yield remaining just below 4%.

Historical US corporate bond yields

Five-year maturity



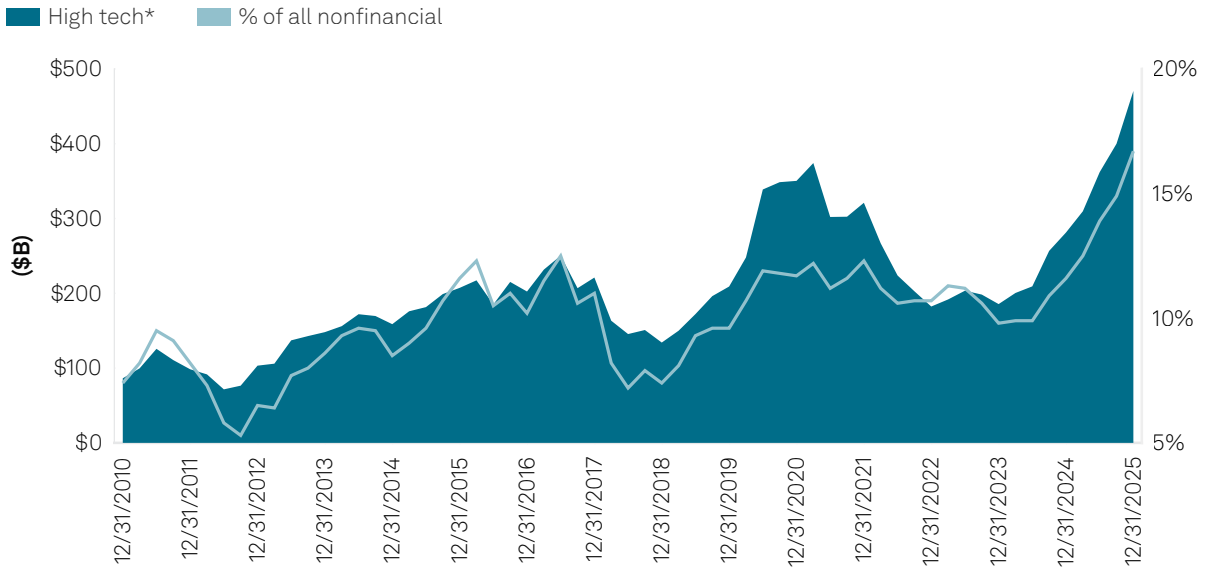
Data as of November 2025.
Source: S&P Global Ratings Research & Insights.

Issuers appear to have adapted to the uneven impact of tariffs, supported by resilient economies and profitability. Conflict in the Middle East and the Russia-Ukraine war have not significantly disrupted economic activity. They occur amid downward pressure on commodity prices due to factors such as increased oil supply from OPEC+. Ample market liquidity has quickly moderated volatility spikes. Future circumstances and outcomes could differ, and these geopolitical event risks are just one manifestation of deeper structural changes at play.

Sector concentrations surge amid strong bond issuance

The tech sector, particularly expectations surrounding the transformative potential of AI, drives a significant share of market buoyancy. The same is true for bond markets. The AI investment boom coincided with increased issuance from high-tech companies. Occasional “digestion phases” for AI investment and adoption are likely, but these should occur during periods of structural growth, which could support strong issuance. The proportion of high-tech issuance to the total is now roughly equal to that of utilities, the usual leader, at close to 17% of the global nonfinancial corporate total in the 12 months through November 2025. We expect additional capital expenditure of between $4 trillion and $5 trillion through 2030. This could be too large for the bond market to absorb alone, but debt financing should remain part of the funding mix.

High-tech issuance leaps alongside AI investment

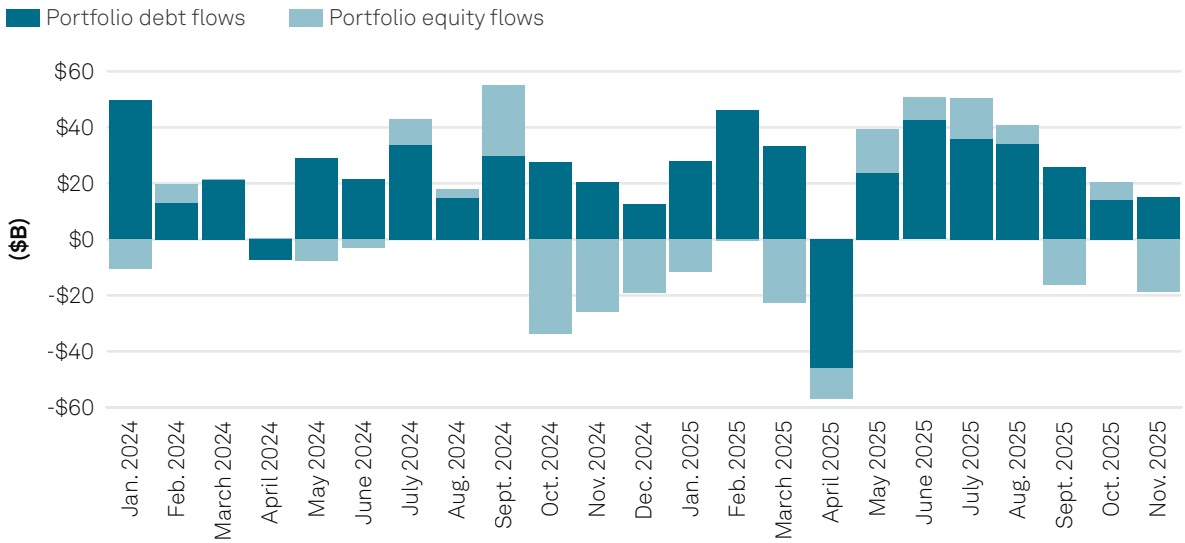


Data as of December 2025.
* Trailing four quarters, fourth quarter 2025 through Dec. 12.
Sources: Refinitiv; S&P Global Ratings Credit Research & Insights.

Growing domestic bond markets add diversification to funding options

We anticipate local-currency debt markets to develop in many large emerging economies. This will improve and diversify corporates' access to financing and provide a buffer against external volatility as the effects of increased trade and geopolitical tensions add to a fundamentally fragile environment. These markets are not immune to contagion risks if crises emerge in specific sectors or if there is an asset-price correction in the US. Less dependence on US dollar funding for emerging market borrowers offers greater diversification and can reduce currency mismatches, although such funding will remain predominant due to the smaller size of these borrowers' domestic capital markets. Transparency and macroprudential supervision need further improvement as these markets mature.

Debt flows mostly positive over the last 2 years



Data as of Dec. 10, 2025.
Net nonresident purchases of emerging markets stocks.
Sources: IIF; S&P Global Ratings.

Innovations around bond market infrastructure should ultimately enhance liquidity

Market digitalization will progress unevenly, but will eventually increase liquidity

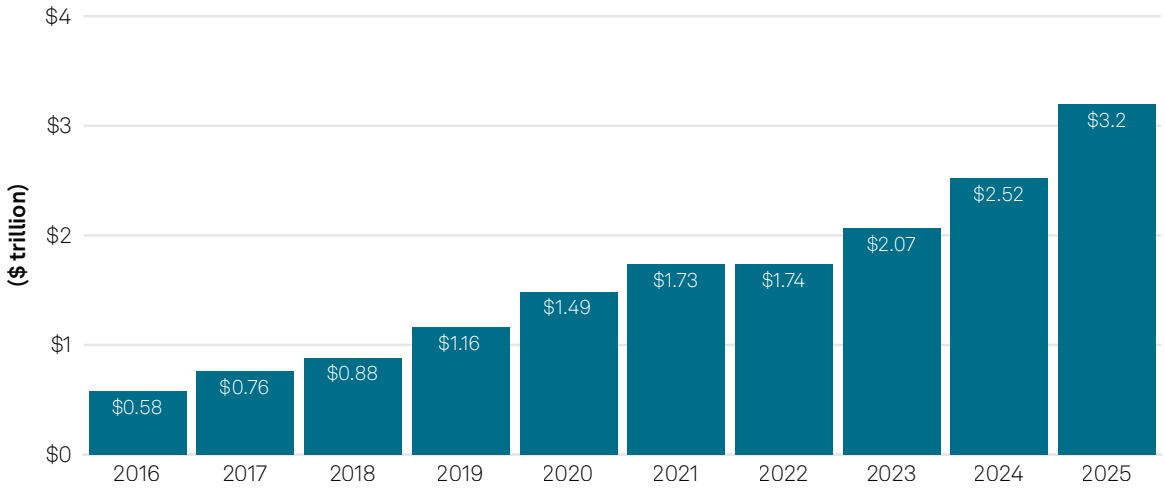
Tokenized money market funds have expanded rapidly since early 2024, backed by traditional short-term US government obligations. These funds are used as collateral in decentralized finance and could grow substantially if they become eligible collateral in the broader financial market, particularly for derivatives.

Yet, tokenization volumes are limited, and robust secondary markets are yet to materialize. Technical interoperability challenges and a lack of widely accepted solutions for making on-chain cash payments are key obstacles. Adoption may be uneven as regulatory frameworks emerge at varying paces; momentum is greatest in the US. We expect tokenization to initially scale in the collateral operations of financial markets, as the ability to instantly swap an asset for a cash payment, part of a single transaction, will bring tangible commercial benefits to financial institutions involved in repurchase agreement transactions and intraday liquidity management. Digital bonds rated by S&P Global Ratings have been primarily issued by sovereigns and supranational entities whose debt is often used as collateral.

Stablecoins are increasingly being positioned as an essential pillar for enhanced liquidity and efficiency, to bridge traditional and digital markets and enable instantaneous settlement with lower fees. Improved network effects and regulatory clarity could speed up adoption. As interoperability improves and trusted on-chain cash payment tools, such as regulated stablecoins or central bank digital currencies, gain traction, the market is poised for exponential growth, with tokenized assets offering real-time settlement, fractional ownership and democratized access to capital. While initial digitalization may progress unevenly, the maturation of digital asset infrastructure could ultimately federate markets and enhance transparency.

The expansion of fixed income ETFs has affected market efficiency and investor accessibility

Assets under management for fixed income exchange-traded funds



Data compiled Dec. 6, 2025.
Sources: ETF and benchmarking data; S&P Global Market Intelligence.

Global fixed income ETF assets under management reached $3.2 trillion as of Dec. 6, 2025. Strong growth momentum has emerged in the US and Europe, Middle East and Africa markets. Passive strategies maintain a healthy dominance (82% market share), but active bond ETFs surged 52% year over year to $0.59 trillion in AUM, signalling investors' increasing appreciation for strategic credit selection capabilities. Investor allocation has diversified across fixed income segments, including Treasury securities, core fixed income, investment-grade corporate credit and high-yield instruments, bolstered by favorable yield environments and attractive expense ratios. This points to enhanced market accessibility and innovative product development. Passive investment remains core, but active investment is a material growth driver, especially when it comes to determining precision in credit selection, term structure and securitized niches.

Bond ETF usage has increased due to its structural advantages, which enhance market efficiency. They facilitate diversified fixed income exposure without the operational complexities inherent in individual bond acquisition. They also enhance transparency, including through intraday pricing visibility. Cost efficiencies, including reduced expense ratios relative to active management alternatives, combined with excellent execution flexibility, have accelerated adoption rates. We believe that potential liquidity differences between ETF secondary market trading and the underlying bond market depth are being increasingly well managed. The price discovery function of ETFs relative to underlying bonds has enhanced market transparency and efficiency in the overall financial ecosystem. ETFs have demonstrated considerable resilience across market conditions, and mechanisms are evolving to address potential stress scenarios.

Bond ETFs have created an additional liquidity layer, allowing investors to transfer risk exposure efficiently without requiring transactions in the underlying securities, enhancing secondary market effectiveness. They have also democratized bond market access, providing enhanced portfolio construction capabilities for both retail and smaller institutional investors. As the market matures, these instruments are proving their value as essential components of modern investment strategies, offering unprecedented access, efficiency and flexibility in fixed income allocation.

Cautious optimism from structural shifts

Global bond markets have adapted to shifting policy regimes and geopolitical uncertainty, but this resilience should not be taken for granted. Uneven progress and new challenges are likely, particularly as market structures and digitalization continue to evolve. Innovations are laying the groundwork for greater efficiency and flexibility, and, ultimately, these structural shifts offer reasons for cautious optimism, even if the journey remains complex and nonlinear.

On the rails: Read on to find out how bond index fund managers balance the need to maintain their benchmark alignment while capitalizing on opportunities during periods of market uncertainty.

The right tools can help bond index funds stay on track

Index fund investors can benefit when funds closely track benchmarks

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Highlights

Fully replicating a bond benchmark can be challenging because of the breadth of the bond market and the limited liquidity in certain market segments.

Successful bond index fund management hinges on aligning a portfolio's key risk factor exposures with those of its benchmark to minimize tracking error and transaction costs.

Deep investment expertise and collaboration help bond index fund managers achieve tight benchmark tracking.

An index fund is designed to capture the risk and return of an appropriate benchmark. While achieving that sounds easy, it requires a sophisticated approach. The challenges are amplified for bond index fund managers because of the breadth and liquidity features of bond markets. This research explores how bond index fund managers, amid uncertain and dynamic markets, navigate complexity and volatility to keep portfolios closely aligned with their benchmarks while remaining agile enough to seize opportunities.

Bond index fund managers face unique challenges

Equity index fund managers typically achieve tight benchmark tracking by owning all index securities in their proportional weights. For bond index fund managers, this is generally impractical because the bond market is so large — the Bloomberg US Aggregate Bond Index contained nearly 14,000 securities as of September 2025 — and many bonds trade with limited liquidity.

Sampling is one tool for managing this complexity. By selecting a representative set of bonds, fund managers aim to align the portfolio's principal risk factors with the index's. While risk factors such as duration, credit quality, sector and issuer exposure are some of the most important to match, dozens are often incorporated into the investment process.

However, sampling alone isn't enough. Managers use advanced techniques that integrate multifactor risk analysis and optimization methods (for example, quantitative tools that find the best combination of bonds) to construct portfolios that balance expected risks, returns and costs to minimize tracking error.

Risk alignment and cost management can help improve investor results

To demonstrate this balancing act, we simulated the performance of two hypothetical portfolios and compared the tracking error of each against the Bloomberg US Aggregate Bond Index.

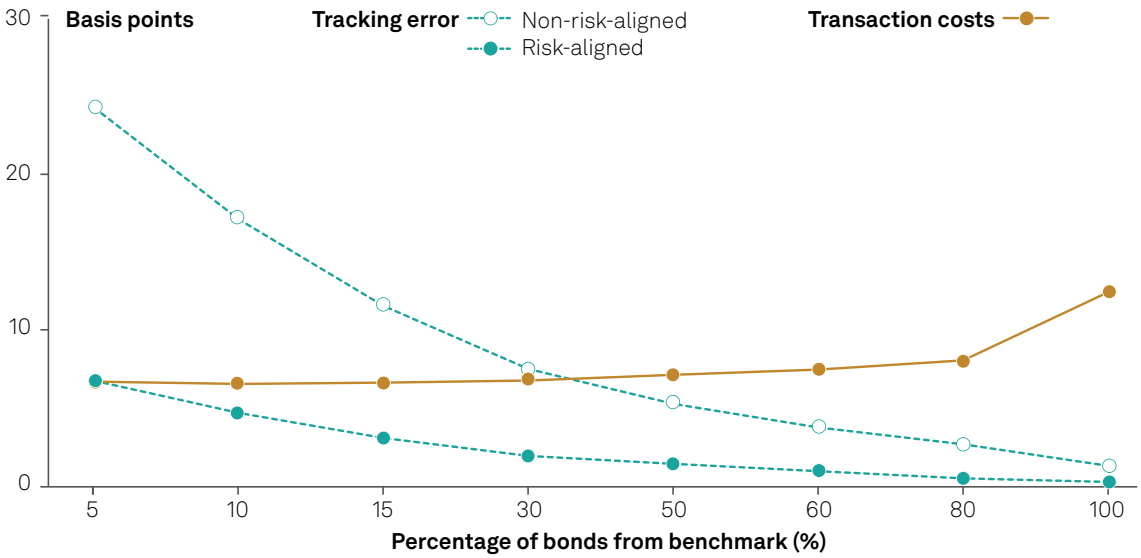
The first (the "risk-aligned" portfolio) randomly sampled bonds from the benchmark and aligned the portfolio's duration, credit quality and sector exposures with the benchmark's. This analysis focused on these risk exposures, given their sizable impact on bond returns.[5] The other (the "non-risk-aligned" portfolio) also randomly sampled bonds from the benchmark but did not match its risk factor exposures.[6]

The chart below highlights two items:

1. Tracking error declines as portfolio size increases, with the risk-aligned portfolio consistently showing lower tracking error than the non-risk-aligned portfolio.

2. Estimated transaction costs increase with portfolio size. This underscores the need to balance both, which experienced managers carefully navigate, particularly during volatile markets when liquidity and trading costs can shift quickly.

Risk factor alignment strikes balance between tracking error and transaction costs



Each tracking error data point represents the estimated median monthly tracking error across 500 simulations of each portfolio that contains a given percentage of bonds from the benchmark, the Bloomberg US Aggregate Bond Index.
The rescaled weights for each portfolio sum to 1. The percentages of bonds included in each portfolio are rounded to the nearest 5-percentage-point increment and are based on the average number of monthly benchmark constituents.
Tracking error is calculated as the standard deviation of the monthly excess returns between the portfolio and the benchmark. Each transaction cost data point represents the monthly round-trip cost, quoted in price, to trade an entire portfolio (that is, 100% turnover) that contains a given percentage of the bonds in the benchmark. We estimate portfolio-level transaction costs based on group-level transaction costs across key market sectors (such as Treasurys, mortgages and corporates) and input from Vanguard's Global Bond Index team. Trades are assumed to be done pro rata across each sector in the benchmark based on average monthly sector weights.
Aligning a portfolio's risk factor exposures with the benchmark's is paramount for precise bond benchmark tracking. It helps minimize risk-based tracking error and reduce transaction costs because fund managers can avoid trading the most expensive bonds.
Sources: Vanguard calculations, using data from RIMES, Bloomberg and MarketAxess® from October 2020 through September 2025.

Aligning a portfolio's risk factor exposures with the benchmark's is paramount for precise bond benchmark tracking. It helps minimize risk-based tracking error and reduce transaction costs because fund managers can avoid trading the most expensive bonds.

5 The risk-aligned portfolio matched the benchmark's duration, credit quality and sector risk factor exposures by sampling bonds from the benchmark and rescaling their weights accordingly. For further details, see Fabozzi, Frank J., Steven V. Mann, and Francesco Fabozzi, 2021. *The Handbook of Fixed Income Securities, Ninth Edition*. McGraw Hill.

6 For more detail on portfolio optimizations, see Markowitz, Harry, 1952. Portfolio Selection. *The Journal of Finance*. https://www.jstor.org/stable/2975974.

Collaboration is key to navigating complex events

In June 2025, a credit event involving Warner Bros. Discovery (WBD) showcased how Vanguard's Global Bond Index (GBI) team adds value through risk alignment, cost management and opportunistic positioning. A few months earlier, our Credit Research team flagged signs of WBD's credit-quality deterioration and the potential downgrade to high-yield, or below investment grade, which could cause WBD's bonds to be removed from the Bloomberg US Aggregate Bond Index. Subsequently, GBI partnered with Credit Research to analyze tender offer details, index implications and capital structure changes to inform risk management and portfolio positioning.

Using Credit Research's insights, the GBI team initially aligned portfolios with the Bloomberg US Aggregate Bond Index's risk exposure for WBD bonds while favoring those bonds most likely to be tendered. When WBD restructured its debt later in June and did a tender/exchange, the GBI team capitalized on favorable pricing by exchanging its existing WBD bonds for new issues. The new bonds then outperformed — by nearly 12 percentage points, in some cases — legacy WBD bonds that remained in the benchmark for the rest of the month.

These actions helped the GBI team preserve investor capital, avoid holding legacy bonds that could create future tracking error, add incremental return and sidestep transaction costs.

Investors benefit when index funds closely track benchmarks

Achieving tight benchmark tracking ensures that bond index funds deliver the market return investors expect. This is critical during periods of market volatility, especially because bonds typically act as a stabilizer against equity market sell-offs. For investors, choosing a bond index fund that tracks its benchmark closely helps enable the fund to fulfill its role in a portfolio when that matters most.

Despite the challenges posed by market volatility, bond index fund managers remain focused on delivering precise benchmark tracking. Volatility can affect transaction costs and liquidity, yet it also creates short-lived opportunities. Bond index fund managers achieve their objective by focusing on key risk drivers, controlling costs and acting decisively when opportunities arise, turning complexity into a disciplined pursuit of value.

Notes:

All investing is subject to risk, including the possible loss of the money you invest. Past performance is not a guarantee of future results.

Investments in bonds are subject to interest rate, credit and inflation risk. Bond funds are subject to the risk that an issuer will fail to make payments on time, and that bond prices will decline because of rising interest rates or negative perceptions of an issuer's ability to make payments.

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Going private: Next, we will turn our attention to the increasingly popular private markets. We consider how the adaptability of private credit has fueled its significant growth, and how the alignment of general partner and limited partner interests is essential to further expansion.

Unlocking the next stage of private credit's growth

A global, cross-divisional perspective on the key drivers of future growth and the evolution of private markets

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Evan Gunter, Director and Lead Analyst, Private Market Analytics, S&P Global Ratings
Ilja Hauerhof, Director, New Product Development, S&P Global Market Intelligence
Ari Rajendra, Head of Private Markets, S&P Dow Jones Indices

Highlights

Private markets are transforming global financial markets through private equity and private credit. The key to unlocking the next stage of growth lies in advancing transparency and data-driven insights.

Credit assets under management of the five largest private credit managers more than doubled between 2020 and 2025, reaching $2.0 trillion. S&P Global Market Intelligence's Quantitative Research & Solutions group projects that the credit AUM of these firms will top $3.3 trillion by the third quarter of 2029.

Asset-based finance (ABF) has emerged in recent years as one of the fastest-growing credit strategies within private credit portfolios. We expect ABF to surpass $1 trillion in AUM in the portfolios of the five largest private credit managers in 2029.

Private equity and, more recently, private credit have transformed both investor portfolios and global financial markets. The ever-evolving offerings from the asset classes have attracted more investors, while the valuation of private companies has grown exponentially. Further growth hinges on efforts to improve transparency for investors, to provide standardized performance benchmarks to ensure private market allocations meet long-term objectives and risk budgets.

The growth and evolution of private markets

"It is not the strongest of the species that survives, nor the most intelligent, but the most adaptable to change," goes the famous saying by Charles Darwin.

Markets are constantly evolving. One of the most significant and transformative developments in the global financial system since the Global Financial Crisis has been the rapid growth and evolution of private markets.

Private markets have reshaped the way investors think about diversification and portfolio construction. Private credit, private equity, secondaries, venture capital and real assets have become integral components of multi-asset portfolios for a broadening investor base, from global pension funds and sovereign institutions to insurance companies, wealth managers and retail savers. These assets present new challenges for sound risk management practices as private assets are less liquid, more opaque and frequently complex.

These private allocations are transforming capital markets. In equities, more companies are staying private for longer, even as they grow. Some of the largest private companies, such as SpaceX, OpenAI, Databricks and Anthropic, have achieved valuations in the hundreds of billions and are still growing. The valuation of private companies as measured by the S&P U.S. Private Stock Top 10 Index (USD) gained 81% in 2025 through November, outpacing the 16% gain for the S&P 500 over the same period.

While private equity laid the foundation for investors stepping into private assets, it is private credit that has seen the biggest increase in allocations and investment flows since the beginning of 2020. It achieved annual returns of almost 10% without having any full years of negative returns. Although private equity achieved a higher internal rate of return (IRR) over this period, this came with higher volatility.

Private market returns vary by asset class

Private benchmarks (%)

Asset class	H1 2025 IRR	5-year avg. annual IRR*	Max. annual IRR*	Min. annual IRR*
Private equity	5.96%	13.83%	35.88%	-5.89%
Private credit	5.37%	9.12%	15.89%	4.14%
Infrastructure	7.29%	9.94%	14.73%	6.17%

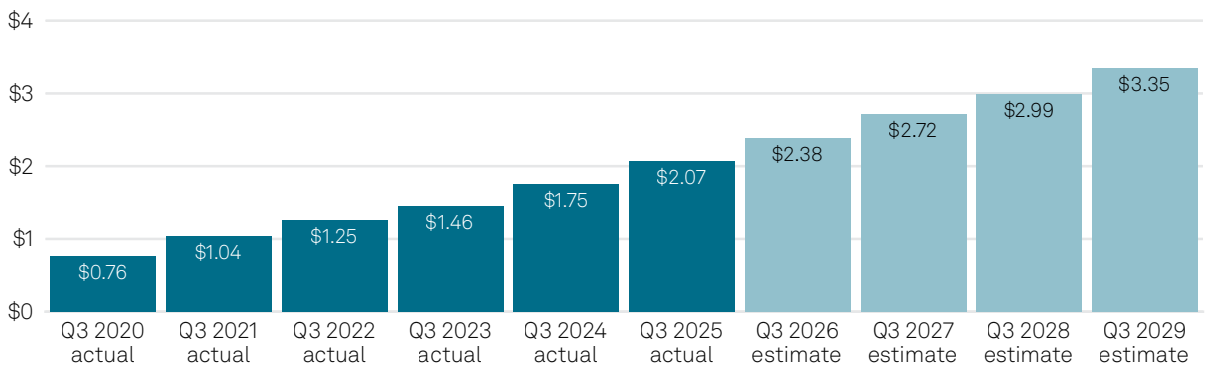
Data for H1 2025 is from Jan. 1, 2025, through June 30, 2025.
* Data for these measures is from Jan. 1, 2020, through Dec. 31, 2024.
IRR = internal rate of return.
Past performance is no guarantee of future results.
Source: Cambridge Associates distributed via S&P Dow Jones Indices LLC.

In the third quarter of 2020, the five largest private credit managers — Apollo Global Management Inc., Blackstone Inc., Ares Management Corp., KKR & Co. Inc. and The Carlyle Group Inc. — had almost $750 billion in credit AUM. This had grown by 174% to more than $2.0 trillion by the third quarter of 2025. We believe the AUM of the five largest managers represents a sizable portion of the private credit market that some estimate already exceeds $3 trillion.

S&P Global Market Intelligence's Quantitative Research & Solutions group projects that the credit AUM of the five largest private credit firms alone will top $3.3 trillion by the third quarter of 2029, based on the analysis of sell-side analyst models for each of the firms individually using Visible Alpha estimates.

Top 5 private credit firms' assets under management estimated to exceed $3 trillion in 2029

Aggregated credit assets under management actuals and consensus estimates ($ trillion)



Data as of Nov. 28, 2025.
Based on Visible Alpha credit segment assets under management actuals and consensus estimates for KKR & Co. Inc., The Carlyle Group Inc., Ares Management Corp., Apollo Global Management Inc. and Blackstone Inc.
Source: S&P Global Market Intelligence, Quantitative Research & Solutions (QRS).

This projects a compound adjusted growth rate of 15% for private credit between 2023 and 2029. In earnings calls, many alternative asset managers are citing even higher expectations for growth of asset-based finance (ABF) within their credit portfolios.

ABF is a key driver of future private credit growth

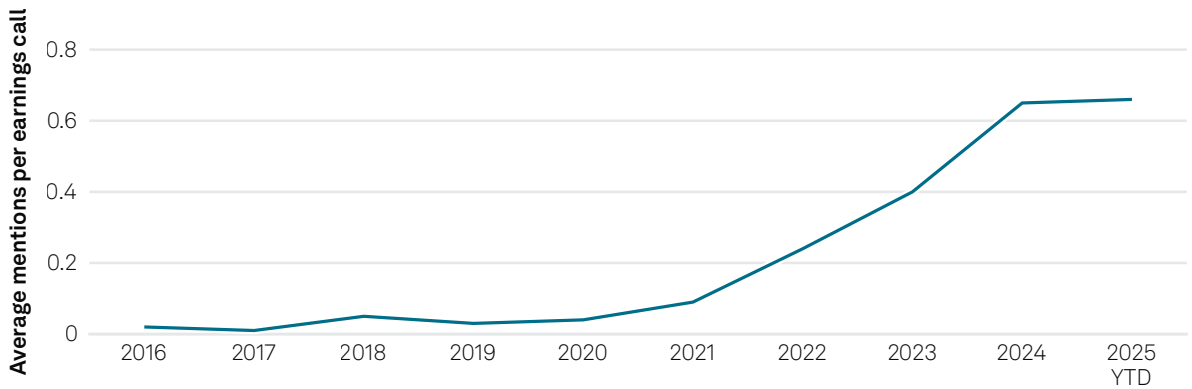
Private credit is expanding beyond its traditional beat of middle-market corporate direct lending. Alternative asset managers have grown in size and scale, becoming more vertically integrated, with platforms that span from origination to distribution. This expansion includes ABF deals involving portfolios of loans or assets that provide contractual cash flows traditionally associated with the public asset-backed securities (ABS) market. These assets range broadly, from royalties (both entertainment and pharmaceutical) to asset leasing and loans (such as aircraft, containers and time shares) and beyond. Even as these ABF deals include complex assets and/or structures, the transparency provided to investors varies and can be limited.

ABF has been part of credit investment strategies for over a decade, but mentions of "asset-based finance" surged sevenfold between 2021 and 2025, according to S&P Global Market Intelligence data from the earnings calls of more than 50 private equity firms.

This reflects the growing momentum of ABF and its increasing importance as a diversified credit strategy for asset managers and their investors.

Private equity earnings calls show increasing interest in asset-based finance

Asset-based finance keyword mentions per private equity earnings call

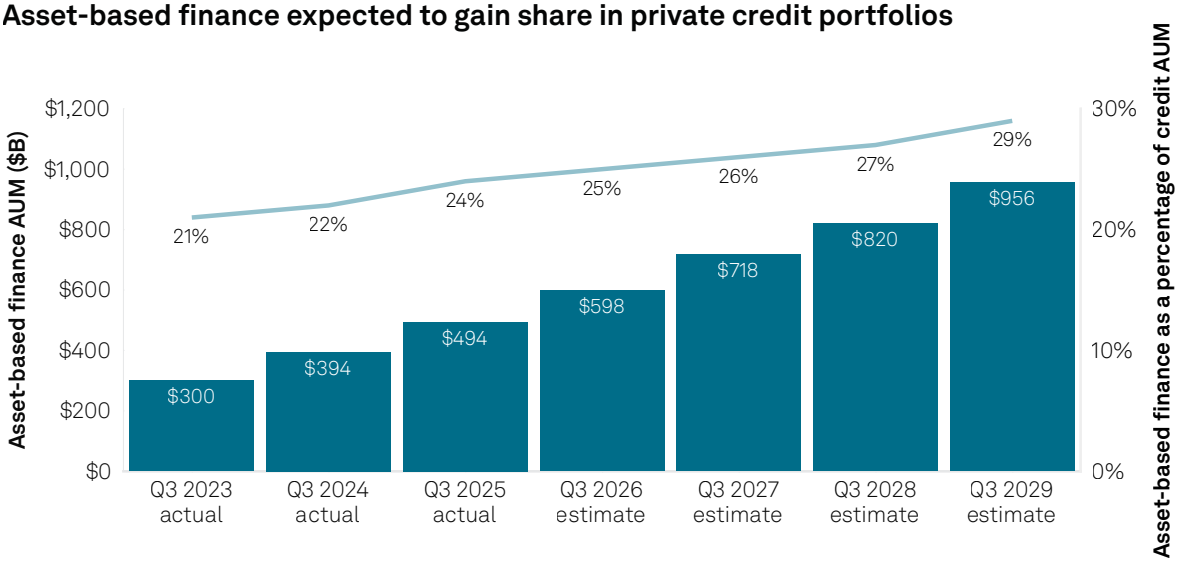


Data as of Nov. 24, 2025.
Keyword mentions include ABF, asset-backed, asset-based, commercial mortgages, consumer loans, development loans and hard assets.
Source: S&P Global Market Intelligence, Quantitative Research & Solutions (QRS).

Private credit investors double down on ABF AUM

Considering the five largest private credit managers again, we see that ABF is poised for growth within the broader credit portfolios. ABF AUM for the top private credit investors surged 25% year over year as of the third quarter of 2025, nearing $500 billion. S&P Global Market Intelligence's projections indicate credit ABF AUM growing at a 21% compound adjusted growth rate, increasing its share in the overall credit portfolio of these firms to 29% in the third quarter of 2029 from 24% in the third quarter of 2025, as ABF AUM potentially approaches $1 trillion in 2029.

Asset-based finance expected to gain share in private credit portfolios



Data as of Nov. 28, 2025.
Asset-based finance assets under management actuals and estimates for KKR & Co. Inc., The Carlyle Group Inc., Ares Management Corp., Apollo Global Management Inc. and Blackstone Inc., based on QRS research.
Source: S&P Global Market Intelligence, Quantitative Research & Solutions (QRS).

Innovation is a hallmark of private credit's evolution

Once synonymous with middle-market direct lending, private credit has become a pillar of debt capital markets. Borrowers from diverse sectors have found that private credit, with its agility and speed of execution, can meet the bespoke needs of increasingly complex transactions in sectors such as fund finance, digital infrastructure and energy transition, as well as provide a source of funding for esoteric assets.

Adaptation is a signature feature of private credit, and its expansion into ABF is just one example of its adaptability.

Through such rapid innovation, private credit has continuously reinvented itself, expanding its traditional footprint beyond direct lending to mid- and lower-market corporates into securitizations, fund finance and infrastructure. As the variety of private credit assets proliferates, alternative asset managers launching new multi-strategy funds have a broad mandate to seek opportunities from across the spectrum.

Yet the expanded size and scale of private markets introduce more opacity and illiquidity into global capital markets. Risks related to the growing leverage and complexity in private credit transactions pose a challenge, as does the lack of regulation, disclosure and systemic transparency in the market. The growing interdependence between alternative asset managers and traditional players in the insurance and banking sectors was flagged by the International Monetary Fund as an area that could amplify shocks to the financial system.

Transparency is key to unlocking future growth

Investors have been willing to accept illiquidity, new complexities and limited transparency in exchange for the expectation of higher risk-adjusted returns and diversification benefits. This has made the comparison of performance within and between asset classes challenging, with access to information dependent on what the general partner is willing to provide.

This is quickly changing. Investors are increasingly seeking objective benchmarks, standardized reporting and tools that support clear and consistent analysis, attributes long associated with public markets and sound risk management practices. The market growth also highlights the need for a standardized language to define exposures, determine allocation sizes and evaluate performance relative to public and private alternatives. Each is critical for ensuring that private market allocations align with long-term objectives and risk budgets.

There is a push for private markets to strengthen the infrastructure required to expand access responsibly by supporting clearer reporting, better governance and more transparent communication of risks.

Private markets appear to be the next frontier for investors. The evolution of private credit, including its expansion in ABF, is especially notable. As private markets generally, and private credit specifically, continue to mature, adapt and innovate, we expect more transparent, rules-based, data-driven insights will serve as the foundation of a more accessible, comparable and well-understood private market ecosystem.

And finally: While the outlook for private equity is generally positive, there is no guarantee such investments will outperform their public market peers. We examine how the optimal combination of manager selection, diversification and discipline can contribute to a successful investment strategy.

An optimistic but measured outlook for private equity

Successful stakes entail discipline, diversification, flexibility with liquidity and rigorous manager selection

Bill Stout, Vanguard Head of Private Markets Strategy
Ankul Daga, CFA, Vanguard Senior Manager and Investment Strategist
Douglas M. Grim, CFA, Vanguard Senior Researcher, Investment Implementation
Rich Powers, Vanguard Head of Private Equity Product Management

Highlights

Private equity investments face several near-term challenges, but over the coming decade, we expect that high-quality managers with reasonable fees will deliver high-single-digit annualized returns, outperforming public equities.

Investors should prioritize rigorous manager selection and diversification because of the high level of manager risk, partnering with firms that secure lower costs.

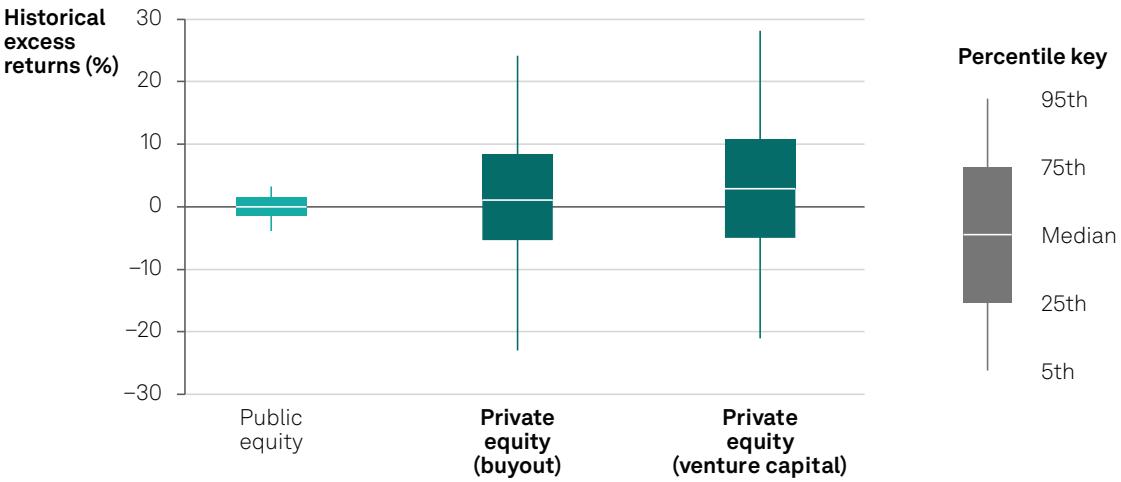
Investors should also commit to a consistent private equity investment strategy and maintain flexibility with liquidity.

Private equity managers are navigating a challenging backdrop, with elevated borrowing costs and constrained exit opportunities. Secondary market volume — that is, the trading of fund interests — has risen. At the same time, discounts to net asset value have held steady, while fundraising has slowed amid the exit backlog. Despite this environment, our long-term outlook for high-quality private equity funds remains positive.

Dispersion of fund returns is likely to stay wide

Public equity returns have been strong, and private equity assets have grown significantly, but private equity funds in the top two quartiles of long-term performance have continued to deliver excess returns (Brown et al., 2024). While the asset-weighted return of buyout funds has underperformed a public index over the past few years, short-term stretches like this are not new (Rabinovich and Schweitzer, 2025). Despite the private equity industry's maturation, the dispersion of excess returns remains significantly wider than for public equity funds and is at an absolute level close to historical norms, underscoring the continued importance of high-quality manager selection.

High-quality manager selection remains critical given high PE fund dispersion



Analysis of public equity funds is based on their annual net-of-fee excess return over each fund's benchmark, using 10 years of global active fund performance data as of Dec. 31, 2024. Calculations use net-of-fee data for private equity funds from vintage year 1998 to 2024. Excess returns are annualized and represented by "Direct Alpha." Direct Alpha is an annualized measure of excess return that compares the performance of a private investment with the hypothetical return of a public market index, assuming an identical cash-flow pattern. Direct Alpha for buyout is computed against the Russell 3000 Index and venture capital is computed against the Russell Microcap Index. For details on the methodology used to calculate Direct Alpha, see Gredil, Griffiths, and Stucke (2023).
Past performance is not a guarantee of future results. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.
Sources: Vanguard calculations, using data from Morningstar and MSCI.

Valuation spreads remain reasonable

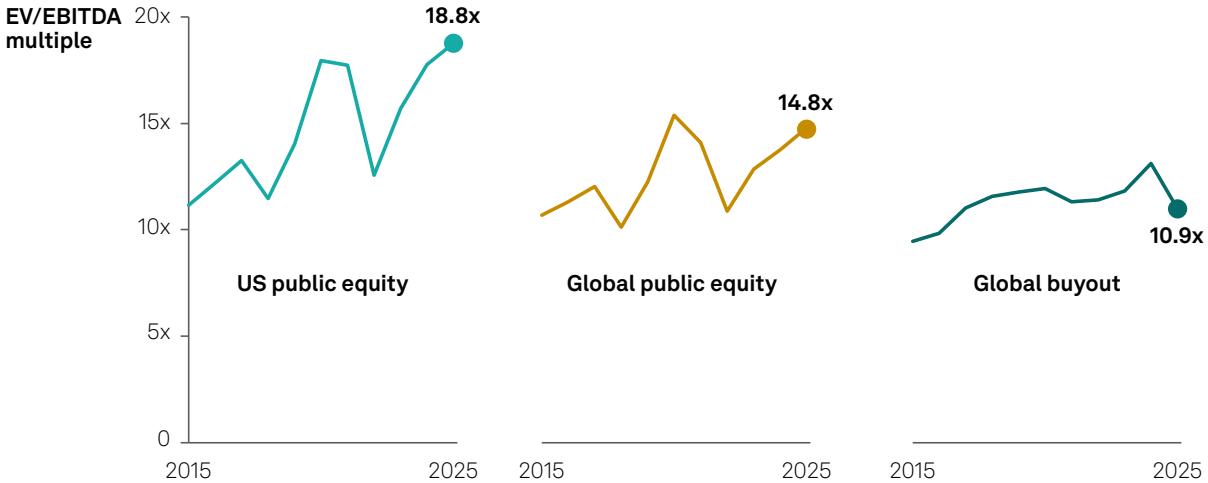
Valuations remain elevated across private and public markets, but the spread continues to support the case for a private equity liquidity risk premium. In addition, secondary market volume for investors who demand liquidity continues to provide attractive opportunities for skilled managers to find high-quality assets at attractive prices.

Fees may be sticky without negotiating power

Fees directly affect investment returns, yet despite the tendency in other markets for fee percentages to decline as assets grow, private equity fund fees have remained relatively stable (Callan, 2024). Firms that negotiate lower management fees can boost net performance for investors.[7]

7 For more on the topic of fee variation within private equity funds, see Begenau and Siriwardane (2024).

Valuations for private companies are attractive compared with public markets



The global buyout EV/EBITDA multiple is computed as the equal-weighted average of the median global buyout multiples of enterprise value to earnings before interest, taxes, depreciation and amortization, as reported by Preqin and PitchBook.
While these databases cover distinct sets of deals, some overlap may exist. Averaging across both sources provides a more representative estimate of prevailing valuation levels.
Global and US public equity valuations are based on the MSCI ACWI Investable Market Index and the S&P 500 Index, respectively.
Sources: Preqin, PitchBook and FactSet data as of Sept. 30, 2025.

Earnings growth will be critical

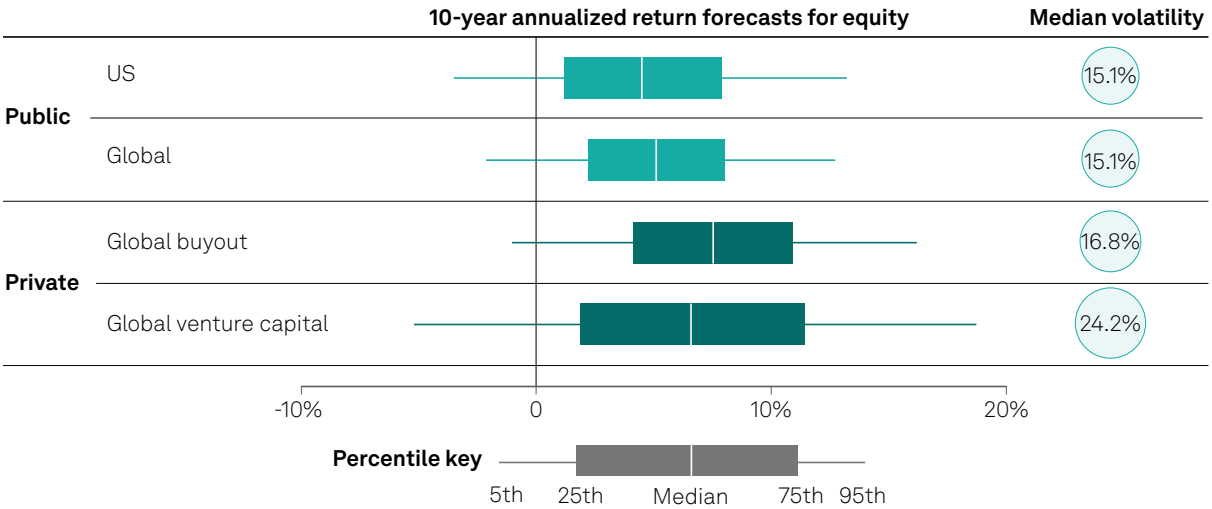
Given stretched absolute valuations, future returns hinge on earnings growth rather than multiple expansion. With leverage less attractive in a higher-interest-rate environment, private equity managers are prioritizing organic growth, operational improvements and strategic acquisitions for their portfolio companies. We expect reasonable corporate earnings growth of approximately 5% annually in the US and about 4% globally over the next decade.[8]

Putting it all together: Forecast

Vanguard's public equity return outlook for the next decade, particularly in the US, is cautious, with a wide range of possible outcomes. In comparison, the net-of-fee forecast for higher-quality private equity funds remains appealing, although the range of possible outcomes is wider given the inherent illiquidity and active risk. If investors gauge the risk of private equity investing by the average volatility of quarterly private equity fund net asset values, they might believe that private equity is safer than the public markets. However, we believe that this measure is artificially low and understates true risk. Our estimates in the chart below suggest the volatility is broadly comparable to that of public equity markets, aligning with theoretical expectations.

8 For more information on our general corporate earnings growth outlook, see the Vanguard economic and market outlook for 2026, available at: https://corporate.vanguard.com/content/dam/corp/research/pdf/isg_vemo_2026.pdf.

Private equity likely to outpace public markets



These return assumptions depend on current market conditions and may change over time. The private equity return expectations are net of fund fees and assume zero manager alpha and a typical risk profile when a diversified program of funds is held. If an investor were able to identify and access high-quality managers with reasonable fees, a task that is challenging and carries significant uncertainty, that would shift the distribution to the right accordingly.
Sources: Vanguard calculations, using data from the MSCI-Burgiss Private Capital Universe sample and asset-return projections from the Vanguard Capital Markets Model (VCMM).
IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results and are not guarantees of future results. Distribution of return outcomes from the VCMM are derived from 10,000 simulations for each modeled asset class. Simulations are as of Oct. 31, 2025. Results from the model may vary with each use and over time. For more information, please see the related notes at the end of this article.

Bottom line

Despite elevated levels of economic uncertainty, we remain positive on the long-term outlook for high-quality private equity funds. Our view is supported by historical performance, fair relative valuations and reasonable earnings growth expectations.

Given the manager and liquidity risks inherent to private equity investing, discipline, diversification, flexibility with liquidity and rigorous manager selection remain critical. Considering there is no guarantee of outperformance, the expected return premium must be high enough to compensate for these risks (Aliaga-Díaz et al., 2022). These factors make private equity unsuitable for some investors. For those who choose to pursue private equity, diversifying across managers, strategies, vintages and regions, sticking to a consistent private equity commitment strategy and partnering with a firm that can negotiate attractive fees can help improve the likelihood of achieving investment success.[9,10]

Notes:

All investing is subject to risk, including the possible loss of the money you invest. Diversification does not ensure a profit or protect against a loss.

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9 For more on the topic of diversification within private equity, see *Benefits of a Fund-of-Funds Strategy in Private Equity* (Vanguard, 2024), available at https://corporate.vanguard.com/content/dam/corp/research/pdf/benefits_of_a_fund_of_funds_strategy_in_private_equity.pdf.

10 For more on the topic of consistent private equity commitment over the temptations of timing, see *Power in Persistence: Staying the Course With Private Equity Commitments* (Rabinovich, 2024), available at https://corporate.vanguard.com/content/dam/corp/research/pdf/power_in_persistence_staying_the_course_with_private_equity_commitments.pdf.

More about the Direct Alpha methodology
Direct Alpha refers to the Gredil, Griffiths, Stucke Direct Alpha method. It is a measure of annualized excess return and compares the relative performance of the private market investment with the stated index as of the measurement date; the calculation is an internal rate of return, based on the series of fund cash flows and the residual value, discounted to a single point in time using the respective index returns; the cash flows are discounted to the same point in time to effectively eliminate the impact of any changes in the stated public equity index from the private market cash flows. For example, a direct alpha of 3.5% indicates that the private investment has generated an annualized excess return of 3.5% over the stated index.

About the Vanguard Capital Markets Model
The asset-return distributions shown here are in nominal terms — meaning they do not account for inflation, taxes, or investment expenses — and represent Vanguard's views of likely total returns, in US dollar terms, over the next 10 or 30 years; such forecasts are not intended to be extrapolated into short-term outlooks. Vanguard's forecasts are generated by the VCMM and reflect the collective perspective of our Investment Strategy Group. Expected returns and median volatility or risk levels — and the uncertainty surrounding them — are among a number of qualitative and quantitative inputs used in Vanguard's investment methodology and portfolio construction process. Volatility is represented by the standard deviation of returns.

IMPORTANT: The projections and other information generated by the VCMM regarding the likelihood of various investment outcomes are hypothetical in nature, do not reflect actual investment results and are not guarantees of future results. VCMM results will vary with each use and over time.

The VCMM projections are based on a statistical analysis of historical data. Future returns may behave differently from the historical patterns captured in the VCMM. More importantly, the VCMM may be underestimating extreme negative scenarios unobserved in the historical period on which the model estimation is based.

The Vanguard Capital Markets Model® is a proprietary financial simulation tool developed and maintained by Vanguard's primary investment research and advice teams. The model forecasts distributions of future returns for a wide array of broad asset classes. Those asset classes include US and international equity markets, several maturities of the US Treasury and corporate fixed income markets, international fixed income markets, US money markets, US municipal bonds, commodities, and certain alternative investment strategies. The theoretical and empirical foundation for the Vanguard Capital Markets Model is that the returns of various asset classes reflect the compensation investors require for bearing different types of systematic risk (beta). At the core of the model are estimates of the dynamic statistical relationship between risk factors and asset returns, obtained from statistical analysis based on available monthly financial and economic data from as early as 1960. Using a system of estimated equations, the model then applies a Monte Carlo simulation method to project the estimated interrelationships among risk factors and asset classes as well as uncertainty and randomness over time. The model generates a large set of simulated outcomes for each asset class over time. Forecasts represent the distribution of geometric returns over different time horizons. Results produced by the tool will vary with each use and over time.

The VCMM's primary value is its utility in analyzing potential investor portfolios. VCMM asset-class forecasts — comprising distributions of expected returns, volatilities and correlations — are key to the evaluation of potential downside risks, risk-return trade-offs and the diversification benefits of various asset classes. Although central tendencies are generated in any return distribution, Vanguard stresses that focusing on the full range of potential outcomes for the assets considered is the most effective way to use VCMM output.

The VCMM seeks to represent the uncertainty inherent in forecasting by generating a wide range of potential outcomes. The VCMM does not impose "normality" on expected return distributions but rather is influenced by the so-called fat tails and skewness of modeled asset-class returns. Within the range of outcomes, individual experiences can be quite different, underscoring the varied nature of potential investment outcomes. Indeed, this is a key reason why we approach asset-return outlooks in a distributional framework.

Indexes for VCMM simulations
The returns of our hypothetical portfolios are based on data for the appropriate market indexes as of October 31, 2025. We chose these benchmarks to provide the most complete history possible, and we apportioned the global allocations to align with Vanguard's guidance in constructing diversified portfolios.

Asset classes and their representative forecast indexes are as follows:

US equities: MSCI US Broad Market Index.

Global equities (unhedged): MSCI All Country World Index.

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