Look Forward

Future of Capital Markets

Volume 10

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S&P Global

Introduction

Volatility and uncertainty are persistent challenges for financial markets, making it difficult to clearly visualize the future of capital markets. Still, financial markets continue to innovate and adapt, with a relentless drive to ensure that they can support and enable future business and capital needs. Private capital and digitalization advance that future by enabling a dynamic and scalable debt capital market.

Tomorrow's complex fundraising needs are already reshaping financial markets, establishing a foundation that is more customized and digital yet also possibly more fragmented. Private credit is funding new loans and debt instruments for thousands of new borrowers. Meanwhile, the growth of digital currencies and tokenized assets may provide the infrastructure to scale these financing avenues. The financial world is steadily increasing the capacity for tailored and creative funding solutions, and new systems for payment and asset transfers are creating new channels through which capital will flow.

Financial innovation combined with new technology could revolutionize the connective tissue of markets and bring the potential to offer customized capital at scale.

Private credit may be more customized and less commoditized, but it lacks a standard market framework. Without such standardization, markets risk becoming increasingly fragmented and illiquid with continued private credit growth.

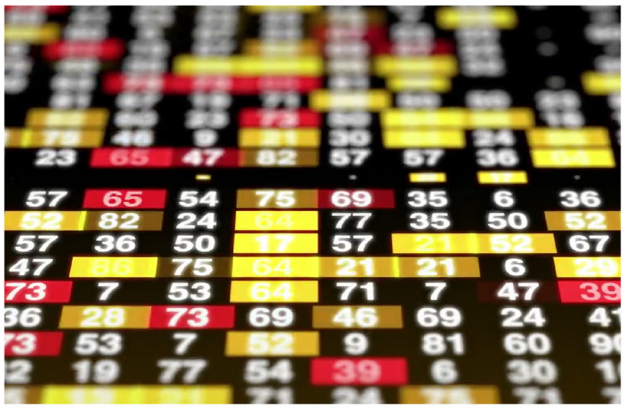
Tokenization will accelerate the pace of capital flows, enabling instant settlement, around-the-clock trading and expanded access to financial products for capital market transactions on a blockchain. Although the technology has been proven in real market use cases, widespread adoption will require a liquid secondary market for tokenized assets. So far, a lack of industry standards and regulatory alignment across jurisdictions has hindered progress.

Taken together, private credit and tokenization could provide enough connectivity between financial market participants to allow private credit to reach new levels in a world where debt capital goes digital. While each of these innovations faces challenges regarding broader adoption and access, the development of AI agents could offer new capabilities for market participants to integrate these technologies at scale, though great care is required to ensure such technology and innovation do not bring adverse, unintended consequences.

The confluence of financial innovation and technological advancements could revolutionize the future of capital markets. This is occurring at a time when much capital is needed to fund transformations in power and digital infrastructure. Financial markets are finding creative ways to address borrowers' needs today, laying the groundwork for markets to meet the demands of tomorrow.

Alexandra Dimitrijevic
Global Head of Analytical Research & Development
S&P Global Ratings

Today's investment innovations are **shaping the structure of tomorrow's capital markets**



Private credit

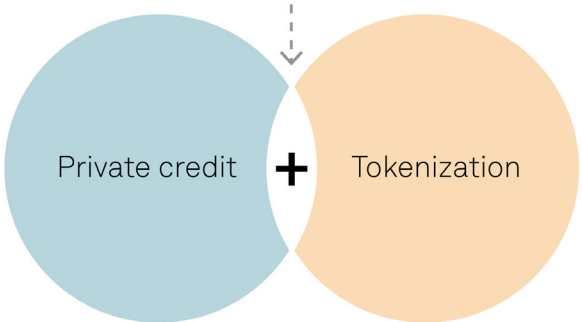
Provides **tailored funding** for a growing multitude of borrowers.

Crypto and tokenization

Promises to **accelerate the pace** of capital flows.

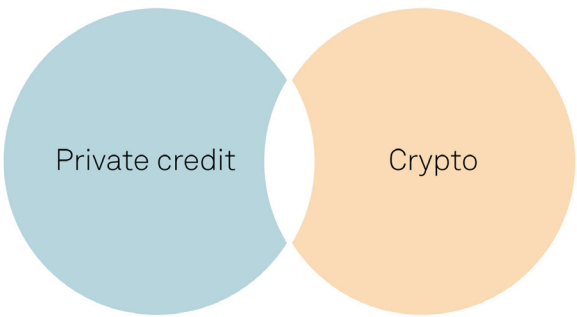
Datacenters, digital infrastructure and **new power supply** are needed to deliver the tokenization and AI of the future.

Impact of **AI agents**



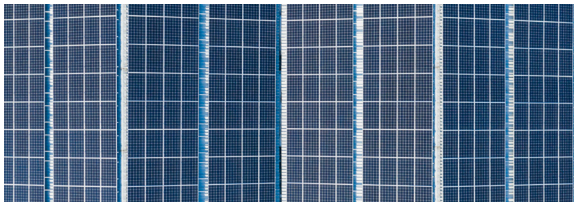
Together, private credit and tokenization offer **customized capital at scale,** and **AI agents offer new capabilities** to integrate these technologies.

ETFs



Exchange-traded funds already provide a **point of entry for crypto and private credit** using the **existing infrastructure** of financial markets.

Contents



Private credit promises bespoke capital

With private credit providing more tailored funding for a growing multitude of borrowers, the credit market could become more fragmented.

Evan Gunter, Director, Lead Research Analyst, Private Markets Analytics
S&P Global Ratings

Dylan Thomas, Private Equity Reporter
S&P Global Market Intelligence

Thierry Grunspan, Director, Financial Institutions Ratings
S&P Global Ratings

Molly Mintz, Lead Strategist and Writer, Private Markets Analytics
S&P Global Ratings

Highlights

With its flexibility, private credit is increasingly being tailored to suit a multitude of different funding situations, from smaller corporate borrowers to fund-based finance, infrastructure and asset-based finance.

As a result, private credit is expected to grow. Increasingly comprised of more borrowers and with more varied instruments, this private credit growth also stands to make the market more complex and less liquid.

As capital markets grow more customized to meet the specific needs of borrowers, new technologies, including AI and tokenization, offer critical tools to help investors navigate an increasingly illiquid and fragmented market.

Innovations in credit markets have a history of transforming financial markets down the line. Changes in credit today can shape the future of capital markets and tomorrow's business environment. Private credit growth is expanding access to debt capital, but this risks making credit more fragmented, with less standardization and more complexity.

Private markets adapt to borrowers' needs

We have seen this before: In the 1980s, the expansion of the high-yield bond market helped unleash a capital funding wave of leveraged buyouts as private equity flexed its role in markets. Further transformations followed that inflection point when broadly syndicated and leveraged loan markets rose as a source of debt capital for predominantly sponsor-backed companies. As originators and arrangers sought to meet the debt capital needs of a wide expanse of borrowers, the growth of the asset class resulted in its eventual commoditization and the establishment of market standards.

Private credit growth over the last decade reflects the next natural progression of this evolution. Inherently more flexible than their predecessors, private markets are already seeing lenders try out new debt structures and terms to fit borrowers' investment profiles and preferences.

With fewer lenders involved in a transaction, private credit can offer a lender flexibility to provide more bespoke solutions for a borrower. This innovation may provide fertile ground for new or innovative instruments. However, not all financial innovations work out for the investor, and it is ultimately up to the investor to assess if a new product offers fair compensation for its risk.

Inherently more flexible than their predecessors, private markets are already seeing lenders try out new debt structures and terms to fit borrowers' investment profiles and preferences.

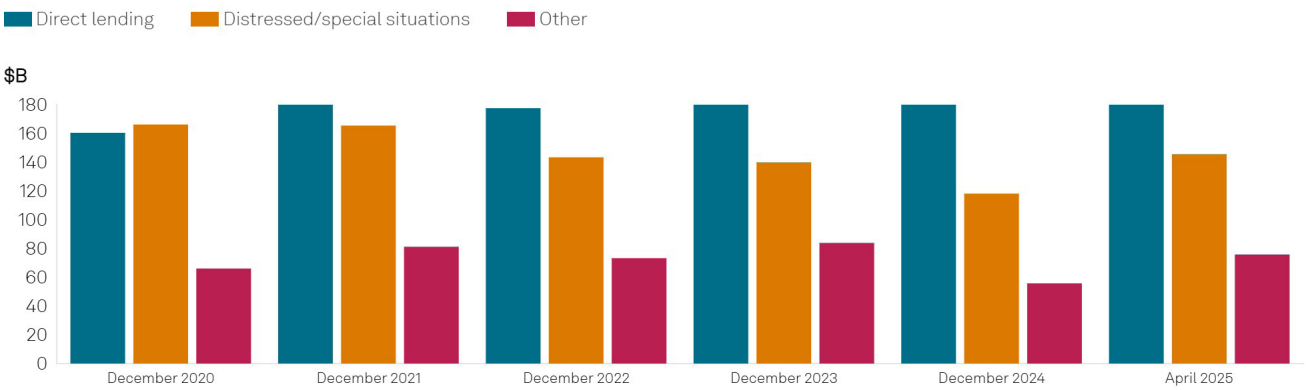
Recent uncertainty in the financial markets has contributed to a slowdown in primary market issuance and M&A activity, creating new opportunities for private credit growth. As lenders look to unlock today's funding challenges, they may be establishing new channels for debt capital to reach corporate borrowers, providing funding for investment funds, infrastructure and asset-based finance. Charting this path forward, a future defined by diverse and disparate funding solutions may mean more opportunities for borrowers. However, it also raises the risk of fragmenting markets, where less commoditization and more illiquidity could shrink the pool of potential buyers for a more specialized instrument.

Expanding markets risk fragmentation

As we have seen in the past, the balance in leveraged finance markets often tilts toward private credit when markets are uncertain or volatile. While high-yield and broadly syndicated loans may have larger scales and offer tighter pricing, private credit can offer more flexibility with more certainty of execution.

Assets under management of private credit funds total nearly $1.7 trillion globally, a considerable share of which is dry powder, waiting to be deployed. With more than $450 billion in dry powder — including nearly $150 billion earmarked for distressed debt or special situations — private credit is poised to expand its footprint in corporate lending. Where uncertainty and volatility can lead to sudden slowdowns in primary market activity for bonds and broadly syndicated leveraged loans, the certainty of execution that private credit offers, coupled with its accumulated dry powder, demonstrates the capacity for private credit growth as an integral source of funding for leveraged finance in the coming years. This shift marks a sea change in credit markets.

Private credit growth is poised to expand with dry powder to deploy



Data compiled April 27, 2025.
Chart shows dry powder available of global private debt funds. Aggregated dry powder trends leverage fund performance and benchmark data provided by Preqin.
Source: S&P Global Market Intelligence.

In contrast to private credit, bond markets are largely regulated with established infrastructure, where banks underwrite and facilitate trading in a transparent and organized secondary market. The rise of broadly syndicated loans marked a step away from this highly regulated and organized bond market because broadly syndicated loans are a private placement instrument. The evolution of the relatively robust and liquid secondary market for broadly syndicated loans is largely due to the continued presence of banks acting as arrangers on these large transactions.

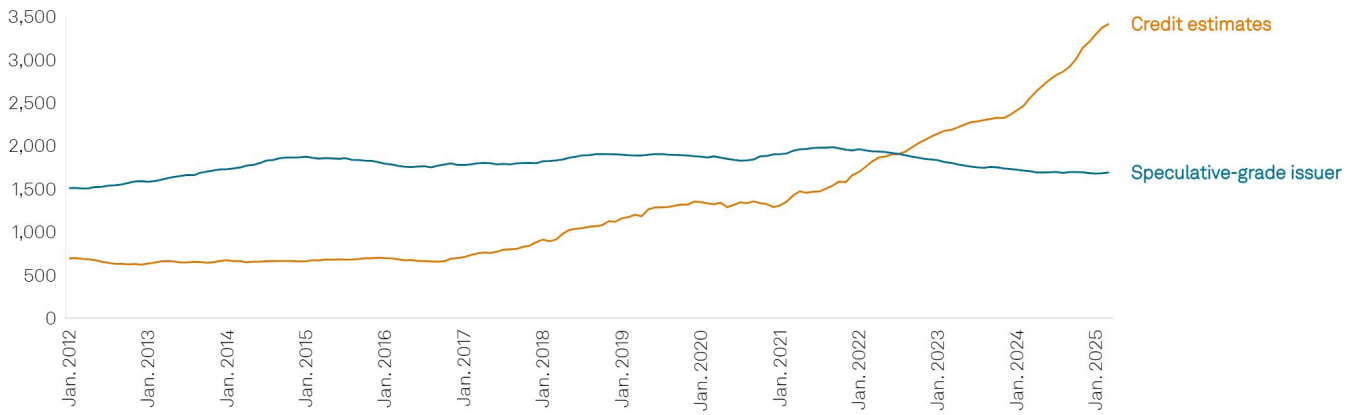
Private credit growth, however, marks a significant progression toward a decentralized source of debt funding, where fully private placement transactions originate through an alternative asset manager. With little to no secondary market for trading, these instruments are treated as buy-and-hold assets that may be suited to long-term investors, but they lack the liquidity of bonds or broadly syndicated loans.

At its heart, private credit is a bilateral agreement between a borrower and a single lender, or perhaps a small club of lenders. With fewer parties involved, the private credit arrangement offers more flexibility of terms, such as payment-in-kind, recurring revenue loans and higher leverage limits. But one lender's comfort in offering these terms to a borrower may not be shared by other investors, and the uniqueness of the instruments heightens the barrier to trading.

Adding to the challenge of trading, private credit borrowers encompass a large pool of small to medium-sized enterprises; tranches tend to be smaller and more difficult to scale, with fewer disclosures that are possibly more complex and have more varied terms; and the instruments lack a system of identifiers.

The quantity and diversity of borrowers in private credit make the job of identifying and comparing credit opportunities even more challenging because the numbers in private credit are vast. In North America, for example, there are nearly 1,700 companies that are publicly rated speculative-grade (BB+ or lower), but the number of borrowers for which we have a credit estimate is close to double, at over 3,100. These credit estimates only represent the slice of the market held by middle-market collateralized loan obligations, which provide a source of funding for private credit lending.

The number of private credit borrowers is growing to a multiple of speculative-grade



As of April 2025.
Sources: S&P Global Market Intelligence CreditPro; S&P Global Ratings.

As the pendulum swings toward private credit growth, more borrowers may turn to it for funding, flexing private debt to refinance public debt. The private credit market stands to grow as a result, with more borrowers and more varied instruments becoming available. While opportunities for better pricing will encourage borrowers with broad investor appeal to refinance private debt in the broadly syndicated and high-yield bond markets, the ranks of private credit are likely to expand as smaller or more specialized borrowers may have few alternative funding options.

Private credit's flexibility helps it to fit the needs of debt capital for many smaller borrowers. But this creates a broad pool of credit instruments, which individually may have relatively few potential investors.

Technological innovations may provide investors with the tools to navigate these challenges. AI agents, responsibly governed, could enable managers to sort through a greater volume of borrowers and potential investments, for instance, and tokenization could provide new ways to trade or distribute private credit instruments.

As the pendulum swings toward private credit growth, more borrowers may turn to it for funding, flexing private debt to refinance public debt. The private credit market stands to grow as a result.

Private credit is adapting its role in fund-based finance

Although alternative asset managers are playing an increasingly central role in financial markets, as managers of both private equity and private credit, funds are also increasingly turning to private credit for debt funding. Lagging M&A activity in recent years has provided fewer opportunities for private equity to exit investments and return capital to limited partners. Meanwhile, private equity fundraising has slowed, creating a challenge for launching new funds.

While different tools for fund-based finance are already well established, private credit is adapting to fund needs.

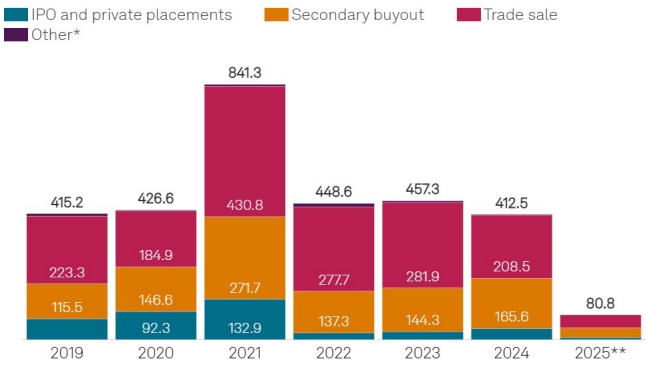
The sources of fund-based finance vary, and private credit is establishing its niche. While banks largely dominate the market for subscription lines of credit — mainly used during the early years of the investment period and backed by uncalled capital commitments from limited partners — the net asset value loan market, secured by the funds' assets and used by funds in a later stage of their lifecycle, is a segment that has seen tremendous private credit growth in recent years.

The growth of assets under management in this segment has been supported by funding from insurance companies and credit funds investing in this space, as well as demand from private equity funds for new sources of funding.

Private equity set a record for exits in 2021, but exits fell off dramatically in 2022 amid rising inflation and a growing buyer-seller divide. The pace of exits has not improved significantly since. Global private equity fundraising declined in 2024 for a third consecutive year as the lack of exits continued to put stress on the private equity fundraising cycle. This trend is slowing the pace of commitments to new private equity fund launches.

Private equity-backed exits by type, 2020–2025

By value ($B)



Data compiled April 4, 2025.
* Includes bankruptcy/write-offs, sale to management and unspecified exits.
** Year to date through March 31, 2025.
Source: Preqin Pro.
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Fundraising trend of private equity funds since 2012

Data compiled Jan. 9, 2025.
Analysis includes capital raised and number of active and closed funds by global private equity funds covering all strategies.
Private market trends data provided by Preqin.
Excludes funds with unknown primary geographic focus.
Source: S&P Global Market Intelligence.
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This slowdown in exits and capital raises is pushing private equity funds to use more debt at the fund level to fund portfolio investments, for instance, or to provide liquidity to limited partners. Private equity funds may also raise more debt through dividend recaps or to fund continuation funds, which acquire the positions of aging funds. With a rising backlog of unsold positions, the assets under management of continuation funds are surging. Overall, leverage in fund-based finance is increasing through funds' use of a growing number of different types of fund financing options, with private credit lenders gaining share in this market.

Funds are now finding ways to unlock liquidity through new and varied types of financings. This may lead to faster ramp-up periods, more exit options and possibly higher leverage for funds going forward.

Given the flexibility available to arrangers of private credit, new structures are emerging that blur the lines between investment funds and structured finance.

Asset-based finance is expanding the boundaries of private credit

Private credit growth into fund-based finance is part of a broader push toward asset-based finance (ABF). Though fund-based finance and ABF may have evolved independently, they are increasingly grouped together in private credit portfolios where investors are seeking assets that offer predictable contractual cash flows. ABF encompasses a broad array of assets, from funds to consumer receivables, as well as more esoteric assets. Given the flexibility available to arrangers of private credit, new structures are emerging that blur the lines between investment funds and structured finance. Funding is evolving as investment vehicles take a page from the playbook of securitizations, including splitting credit risk in tranches.

Opportunities in ABF may have risen in response to a public asset-backed securities market that has become well-established and defined, often with homogenous collateral pools and more established originators. By contrast, the private credit market for ABF may see more variation in collateral and concentration limits and be ripe for experimentation.

This expansion into ABF further demonstrates how private credit offers fertile ground for financial innovation. But rapid advancement and experimentation are swiftly adding to the potential for market fragmentation. A shifting mix of collateral and structures is ramping up the complexity of instruments and the variety of assets within portfolios.

Capital markets march forward

The growth of private credit reflects the next natural progression of a credit journey that goes back at least to high-yield and broadly syndicated loans. With flexibility through cycles and accumulated dry powder to deploy, private credit appears positioned for further growth in capital markets as a tool that lenders can provide to meet borrowers' needs in corporate, fund-based, infrastructure and asset-based finance.

While this expansion is leading to a larger private credit universe, it is a market in which trading and liquidity are restricted by the unmapped, fragmented nature of the assets, leverage is higher, and complexities are unseen. New technology in the form of AI agents may offer investors greater capacity to navigate this universe, but it could also lead to unintended consequences. Financial markets are heading in a direction where credit is more bespoke to meet unique funding challenges. New technologies that can help bring transparency and foster liquidity provide an essential stepping stone to the future of capital markets. ■

This article was authored by a cross-section of representatives from S&P Global. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Accelerating value flow in financial markets through tokenization

Tokenization in capital markets is still fairly new and faces technical and regulatory challenges, but as adoption increases, it will intersect with the growth of private credit and AI as a significant market disruptor over the next decade.

Andrew O'Neill, Managing Director, Digital Assets Analytical Lead
S&P Global Ratings

Molly Mintz, Lead Strategist and Writer, Private Markets Analytics
S&P Global Ratings

Highlights

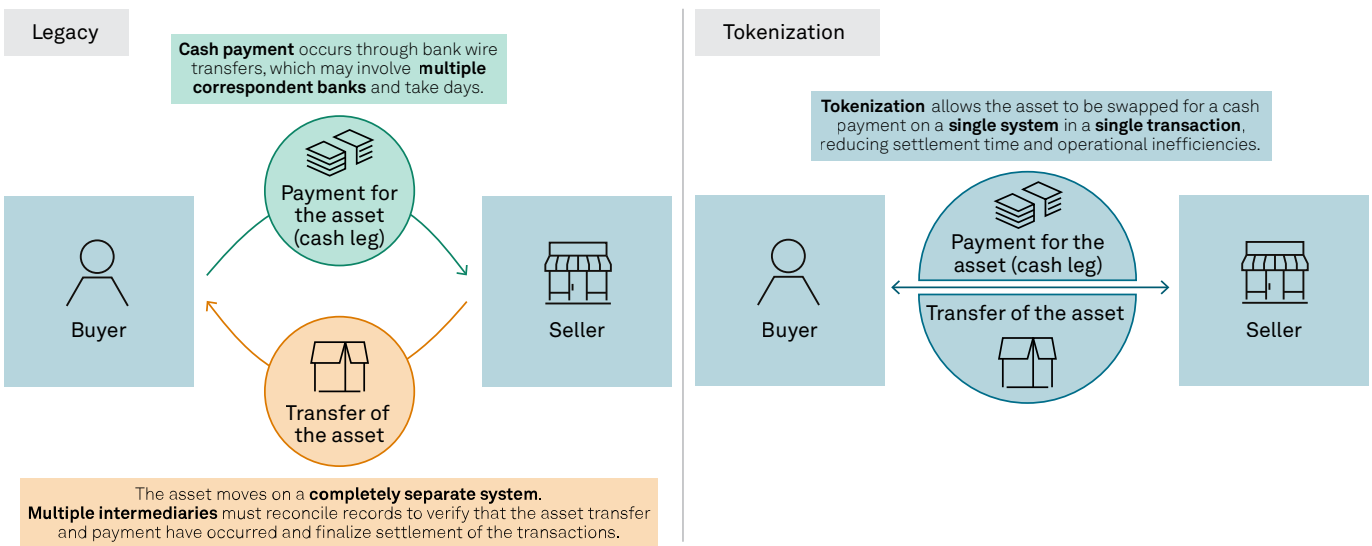
Tokenization enables the transfer and payment of an asset to occur on the same ledger at the same time — a feature in the early stages of adoption that could transform capital markets.

Though applications to date have mostly been narrow and volumes remain low, technical and regulatory roadblocks are gradually lifting. We expect use cases to expand in phases, starting with the tokenization of high-quality liquid assets used in collateral operations, and eventually spread across the credit spectrum.

If the adoption of tokenization increases as expected, it will intersect with other megatrends, such as the growth of private credit and AI, to significantly disrupt the future of capital markets over the next five to 10 years.

Tokenization is the representation of an asset — in this context, a financial security — on a blockchain. Tokenization is gaining momentum as a potentially transformative technology in the financial sector as it offers faster settlement times, reduced counterparty risks and back-office efficiency gains. Transactions have thus far been limited in volume, without any benchmark bond issuances, and a major secondary market has not yet been established. However, progress is accelerating in overcoming technical challenges and adapting regulation to tokenized assets.

Legacy financial market infrastructure hindered by slow settlement times and operational inefficiencies

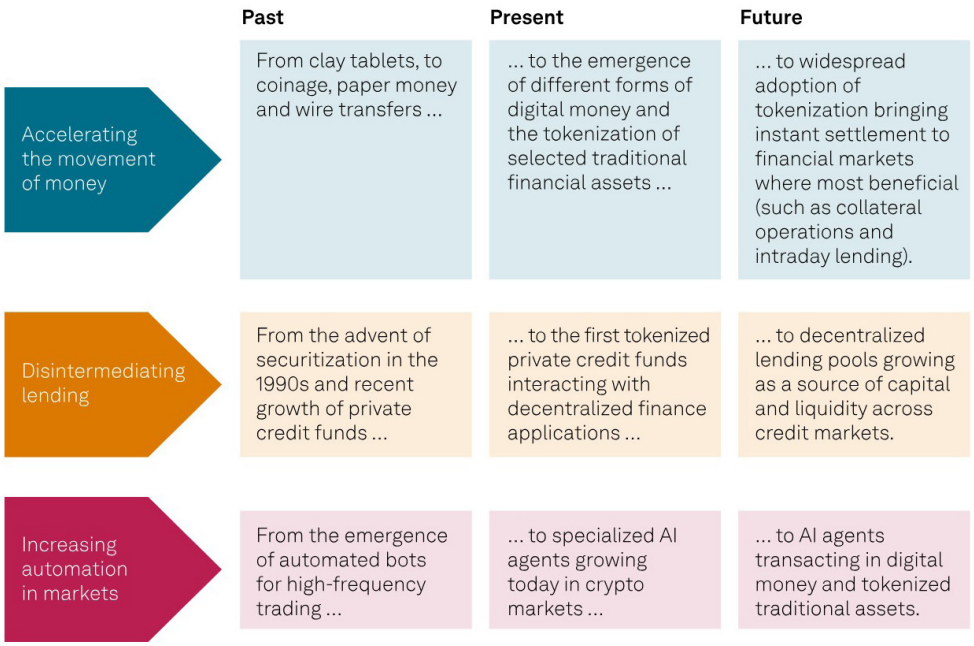


Source: S&P Global.

Tokenization is already in the early stages of adoption. Technical and regulatory hurdles have impeded its scale, but these are being overcome at varying paces depending on jurisdiction and sector. We expect that the adoption of tokenization will advance through three distinct phases:

- Early use cases in highly liquid assets and financial institution collateral operations
- The expansion of these use cases to borrowers/issuers across the credit spectrum
- The interaction of these new tokenized assets with AI agents to revolutionize asset management

Tokenization is a culmination of 3 long-term technological development arcs



Source: S&P Global.

The speed at which money moves has lagged the acceleration of the flow of information since the advent of the internet. Since the failure of Herstatt Bank in 1974, which exposed how settlement risks can contribute to financial instability, financial market infrastructure providers have been trying to reduce settlement times. Tokenization can bring instant settlement times to highly liquid markets and significantly shorten the typically longer settlement times of private markets.

Tokenization can bring instant settlement times to highly liquid markets and significantly shorten the typically longer settlement times of private markets.

Tokenization enables the creation of new capital pools by reducing the need for lending intermediaries. This trend began with securitization in the early 1990s and continues today as private credit markets fragment the traditional lending base. Tokenization will play a role connecting borrowers and lenders in this new landscape. More asset types will be used as collateral for debt financing facilitated by tokenization, which allows for the combination of different asset types.

Tokenized assets and tools to pay for these assets on a blockchain, or on-chain, will enhance automation of markets by enabling AI agents to transact with each other. From streamlining back-office processes to algorithmic trading, financial markets have evolved to automate tasks and accelerate execution. Tokenization enables the use of smart contracts, or software deployed on a blockchain, to automate transactions based on predefined conditions. Automation in financial markets will also allow participants to make transactions without relying on historical payment infrastructures or bank accounts.

This will not all happen at once. Advancements in blockchain for finance in the last two years mean that technical barriers will not be the main roadblock. Legal and regulatory frameworks must adapt to accommodate tokenized assets, and divergence across jurisdictions will somewhat impede progress. We believe that solid commercial use cases will be the main driver of adoption and expect that use cases will expand in phases, starting from the tokenization of assets used in collateral operations, before spreading across the credit spectrum. As adoption increases, tokenization will intersect with the growth of private credit markets and AI to significantly disrupt the future of capital markets over the next five to 10 years.

How adoption of tokenization may unfold over the coming decade

Source: S&P Global.

Phase one (2025–2028): Cross-border payments and collateral operations

We expect tokenization will first scale in the collateral operations of financial markets because the ability to swap an asset for a cash payment instantly as part of a single transaction will bring tangible commercial benefits to financial institutions involved with repo transactions and intraday liquidity management. The digital bonds rated by S&P Global Ratings so far have been issued primarily by sovereigns and supranational entities whose debt is often used as collateral. Since the start of 2024, there has also been a rapid expansion of tokenized money market funds, such as BlackRock's BUIDL fund, backed by traditional short-term US government obligations. These funds are being used as a form of collateral in decentralized finance and could grow substantially if they become eligible collateral in the broader financial market, particularly for derivatives.

Although there have been innovations, tokenization volumes remain limited and robust secondary markets have not yet materialized. Solutions are emerging to overcome the key obstacles impeding adoption — namely, technical interoperability challenges and a lack of broadly accepted solutions for making on-chain cash payments.

For there to be a liquid market in tokenized assets, investors need to access the blockchains that tokenized instruments are issued on and institutions need to connect their legacy systems to these blockchains. This has proved difficult because many tokenized assets use private blockchains operated by a single bank, with access limited to the bank's clients. Different options are emerging to address these challenges, including the use of public blockchains, private permissioned blockchains shared among partner institutions, and cross-chain communication technologies that enable private and public blockchains to interact while mitigating security risks.

Acceptance of on-chain cash leg solutions, including central bank digital currencies (CBDCs), regulated stablecoins and tokenized deposits, will be a key driver of tokenization adoption. Without these, an asset can move on a blockchain but would rely on existing payment networks for cash payments, which does not deliver compelling commercial benefits. Jurisdictions are diverging in their approach, favoring either CBDCs, in the case of China and the EU, or stablecoins, in the case of the US. The choice of CBDC or stablecoin does not impact the benefits of tokenization, but for cross-border transactions, this divergence will require common technical standards and market participants to operate with either tool.

As these hurdles diminish, digital bonds will be issued increasingly with on-chain delivery versus payment, allowing investors and issuers to realize the efficiency gains of tokenization. The Swiss National Bank and European Central Bank have already conducted pilot schemes with market participants to issue digital bonds using a wholesale CBDC for payments. In the US, legislation is expected to support the issuance of regulated stablecoins and bring the necessary clarity and confidence required for the broader adoption of digital bonds. (The US Senate passed stablecoin legislation, the GENIUS Act, on June 17, 2025; approval by the House of Representatives is pending at time of writing.)

Stablecoins and CBDCs are forecast to become ubiquitous in cross-border payments and gain adoption in corporate treasuries. Cross-border payments are a significant area of friction, cost and delay in existing systems. If, by the end of this first phase, the use of stablecoins for cross-border payments expands and corporate treasurers engage with tokenized products such as tokenized money market funds, the greater use of stablecoins in corporate finance will lead to demand for tokenized financing, or loans originated on a blockchain, for companies, setting the foundation for tokenization to spread across the credit risk spectrum.

Phase two (2027–2033): Expansion across the credit spectrum

Once tokenized assets become embedded in the narrow but important operations of financial institutions and corporates, use cases will expand. This will intersect with a trend toward a more disparate lending base driven by private credit markets, with tokenization connecting borrowers to lenders and supporting continued or improved access to capital. For example, in January, alternative asset manager Apollo and tokenization platform provider Securitize announced the tokenization of an existing private credit fund. The companies took this further in May, announcing that investors can borrow on decentralized lending protocol Morpho using the tokenized shares in the fund as collateral.

As corporates increasingly use tokenization for cross-border payments, they will also seek on-chain loans. This may lead to the emergence of fully on-chain collateralized loan obligations (CLOs), where the CLOs are issued as on-chain tokens and a transaction's flow of funds is governed and fully automated by smart contracts. Relative to traditional securitizations, investors in on-chain securitizations will benefit from real-time transparency on the underlying portfolio's composition and performance. This transparency may fuel increasing investor demand for securitizations and funds to be issued in tokenized form.

Relative to traditional securitizations, investors in on-chain securitizations will benefit from real-time transparency on the underlying portfolio's composition and performance.

The growth of on-chain Treasury issuances and use cases of tokenization in securitization will lay the foundations for some large mainstream applications. One particularly impactful scenario would be if US government lending agencies offered on-chain mortgages by the end of this phase, unlocking on-chain mortgage lending. We expect on-chain mortgage lending by commercial lenders to initially remain limited to the small pockets of the mortgage market that are currently underserved. However, agencies' support of on-chain mortgage lending would significantly accelerate adoption and open opportunities for the creation of a high-volume, on-chain residential mortgage-backed securities market.

Phase three (2031–2035): Combined adoption of AI and tokenization

In the next decade, we may see the development of AI agents participating in specific market segments with increasing autonomy. Tokenization would play the important roles of bringing together pools of capital and liquidity, where market-based AI agents would otherwise face fragmentation risks, and providing the technical infrastructure for AI agents to transact with each other. Blockchains could support

transactions between wallets controlled by AI agents, which do not have bank accounts, leading to a new type of participation in capital markets of the future.

The intersection of tokenization and AI could revolutionize asset management and capital markets by increasing access to alternative investments, simplifying downstream processes, and automating asset and value transfer between multiple parties. The use of AI in portfolio construction could help asset managers better tailor portfolios for investors according to risk tolerances, investment objectives and liquidity needs. The expansion of tokenization across asset classes in phase two would make it feasible for asset managers to allocate part of a personalized portfolio to private credit for investors that cannot normally access these exposures, unlocking new capital for the private credit space.

The intersection of tokenization and AI could revolutionize asset management and capital markets by increasing access to alternative investments, simplifying downstream processes, and automating asset and value transfer between multiple parties.

Harmonizing the treatment of public and private assets in portfolio management would create significant value for investment managers and investors. Tokenized private assets could be included in discretionary and model portfolios, enabling wealth managers to offer higher-quality portfolios to their clients. The scalability and interoperability of tokenization solutions would enable seamless portfolio management, allowing fund and portfolio managers, alongside investors, to connect with different networks and manage cohesive strategies.

Disruption in capital markets could come gradually, then suddenly

Amara's law states that people tend to overestimate what can change in the short term and underestimate what can change in the long term. Considering the current volumes of tokenized assets and the challenges that remain in scaling adoption, it is easy to overlook the potential for disruption. But the technology's relatively narrow applications today only target the most immediate commercial benefits. Once the technology is embedded, we may hit an inflection point where use cases expand rapidly and intersect with other megatrends in private credit markets and AI. ■

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Beyond automation: Agentic AI and scaling fragmented financial markets

Agentic AI could transform financial markets, enabling efficient, intelligent decision-making for market participants and helping firms achieve scale in complex, fragmented spaces such as private credit.

Miriam Fernandez, AI Research Specialist, New Product and Analytical Innovation
S&P Global Ratings

Sudeep Kesh, Managing Director, Innovation and Disruptive Technologies Analytical Lead
S&P Global Ratings

Andrew O'Neill, Managing Director, Digital Assets Analytical Lead
S&P Global Ratings

Todd Kanaster, Director, Municipal Pensions
S&P Global Ratings

M. Mercedes Cangueiro, Associate Director, Innovation and Disruptive Technologies
S&P Global Ratings

Highlights

Agentic AI, a relatively new paradigm by which intelligent digital systems can act on humans' behalf through learning and decision-making, could significantly improve operating efficiencies and enhance decision-making in financial markets.

As firms look to grow their capabilities in digital assets and private credit, agentic AI could help asset managers grapple with the complexities that hinder scale in these markets.

Scaling agentic AI systems will take time, owing to the highly regulated nature of financial market participants and their incentives. AI can also amplify potential systemic risks, specifically due to the complexity of agentic AI workflows and speed of execution, therefore spreading contagion in highly volatile situations.

Generative AI and its breakthrough applications are revolutionizing global markets, sectors and industries. The next frontier is agentic AI — systems that do not merely generate but act, plan and adapt autonomously.

Agentic AI applications go beyond passive assistance and allow for dynamic problem-solving, making decisions and executing tasks with minimal human input, unlocking huge potential across industries. This potential should not be underestimated: When used appropriately, agentic AI solutions will further catalyze and accelerate change in how capital markets are funded and scaled.

Over the past decade, the rise of private credit has enabled the seismic growth of nonstandardized credit instruments with bespoke or nonstandard contracts. Unlike the broadly syndicated market, private credit has no real market-based framework to standardize documentation terms and conditions. This presents a growing challenge for asset managers grappling with a large and diverse pool of instruments, where smaller tranche sizes make scale difficult to achieve. Here, AI agents can bring a step-change in efficiency: These systems can interpret unstructured data, evaluate nonstandard contracts and autonomously generate decisions that assist portfolio managers in identifying patterns, risks or arbitrage opportunities at scale.

Meanwhile, digital financial markets, such as crypto exchanges, insurance trading platforms and algorithmic trading platforms, pose challenges to investors due to the complex and interrelated workings between smart contracts and the illiquidity that stems from market fragmentation across multiple chains and protocols. In both cases, the variety and complexity of assets contribute to the inefficiency (or lack) of a secondary market, which is key to a digital financial market's maturation. With agentic AI solutions, firms can move beyond automation and toward intelligent orchestration, optimizing cross-protocol decision-making, asset monitoring and liquidity management to navigate complexity and scale their participation in emerging digital markets.

What is agentic AI?

Agency refers to an entity's capacity to act independently and make decisions. That entity may be a person, corporation, machine or AI software. AI agents for business embody this concept by operating as autonomous intelligent systems that interact with their environment, collect data and perform self-determined tasks to meet predetermined goals with limited human intervention. Levels of agency range from lower to higher autonomy.

For agentic AI systems to meet the needs of a fragmented, unmapped private credit universe, the market needs sophisticated AI agents, not just AI assistants. A fully autonomous AI agent is the most self-sufficient form of agentic AI because it can resolve issues through holistic sensing, planning, acting and reflecting. It not only learns from feedback and environmental interaction but also adapts based on real-time data and analyzes its performance for self-improvement with a robust long-term memory. These agents can better act autonomously to explore different scenarios or generate predictions at, essentially, human-level reasoning capability.

A fully autonomous AI agent is the most self-sufficient form of agentic AI because it can resolve issues through holistic sensing, planning, acting and reflecting.

What differentiates an AI agent from an AI assistant?

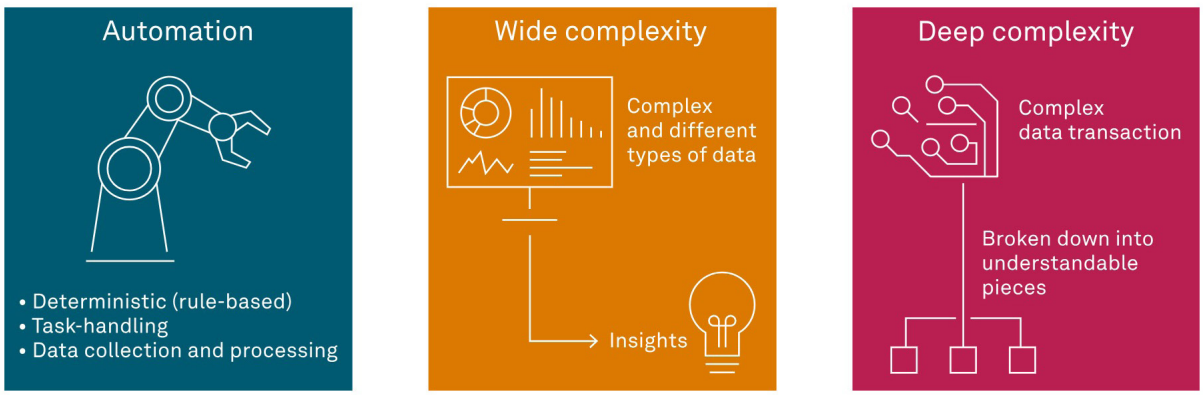
Its ability to...

As of May 2025.
Sources: The Carroll Foundation of True Agentic AI; Gartner; PWC; S&P Global.

Purposes for AI agents in financial markets

AI agents serve different purposes depending on their applications (e.g., consumer, industrial or financial). Execution AI agents already exist in industrial applications, largely based on machine and deep learning, such as preventive maintenance of machinery using telemetry, predicting potential failure that could otherwise lead to costly repairs, defective products, wasted materials, and even health and human safety concerns. As with other AI-related technologies, the integration and adoption of generative AI in many organizations has helped galvanize research and development into how intelligent agents can be used in various value streams, categorized here as automation, wide complexity and deep complexity.

Differences in AI agents in financial markets



As of May 2025.
Source: S&P Global.

Automation

The financial services industry depends on complex administrative processes for decision-making due to its deep history in regulation and level of documentation. Automating these processes would be a natural evolution, owing to technological advancement and incentives to streamline activities that otherwise compress margins for many organizations. Some 60% of financial services companies anticipate that AI agents will bring the most value in 2025 through task automation, according to a survey by S&P Global Market Intelligence 451 Research.

In credit underwriting, for example, AI agents could automate data collection, digitization of physical documents (e.g., deeds, titles, legal documents) and analysis (e.g., cataloging digital information for processing and calibration). Decision-making could be automated as well, but measures would need to be taken to reduce implicit bias and ensure compliance with applicable accountability standards. For tokenization, agentic AI's capabilities could help enable on-chain securitizations, where smart contracts are part of the origination process. The AI agent would be like a digital attorney; it could have a custodial relationship that would allow it to make decisions and execute on the client's behalf.

Wide complexity

Modern financial decision-making, particularly for institutional financial products, involves an increasingly large set of complex factors. These range from traditional elements, such as financial, legal and firmographic considerations, to geopolitical, market (interest rates, volatility, pricing), economic, environmental and digital factors. AI agents could distill this information (e.g., indexing) so a portfolio manager, risk analyst or orchestration agent can consider various factors in a vacuum and understand their interplay, with the AI agent providing transparent, reasoned insights that a human can use in their decision. Human oversight of AI agents will be key to fostering a critical thinking and safety-first mindset. Similarly, agentic AI workflows can be used to create products such as index funds with a trading strategy that aims to exploit some of these factors or

hedge on others. In a private credit market with many diverse borrowers for which limited information is available, this could be a useful application for agentic AI in finance.

Human oversight of AI agents will be key to fostering a critical thinking and safety-first mindset.

Deep complexity

Derivative products, including options or securitized products, use longitudinal data and analytical processes to estimate future curves and forecasts to better understand expected outcomes, risks and adequate pricing schemes. These processes are less about the number of factors than their nuances ("deep complexity"), which allow underwriters, asset managers or analysts to make recommendations with conviction. In this context, AI agents are "digital research assistants" that can help make such recommendations. For example, in private credit, a "deep complex agent" could understand the nuances of unique complex transactions, such as bespoke structuring terms or multilayered capital structures, interacting autonomously with multiple stakeholders. For tokenization, AI agents could help the manager navigate the complexities of smart contracts. Human involvement — scrutinizing the insights deep complex agents provide and connecting them to real-world context and human-aligned values — will be key.

Financial markets may benefit from AI agentic systems across functions and actors, including banks, insurers, asset managers, private equity and brokers. AI agents tend to specialize in specific tasks and can interact with other AI agents or multi-agent systems to perform complex workflows that comprise multiple tasks, where orchestration to ensure coordination and control is crucial. AI agents tend to rely on stochastic models, which is a limitation for zero-error risk tolerance situations. For that reason, human judgment and oversight will remain critical. Areas where agentic AI may benefit efficiency, enhance risk management and boost new revenue streams include:

- Trading and investing-related activities, including investment research and advice, sentiment analysis, algorithmic high-frequency trading, and trading assistants
- Document management tasks, including back- and middle-office operations, automated due diligence, client onboarding, and claims streamlining
- Risk management of liquidity needs and market risk, regulatory compliance, fraud and market manipulation monitoring, supply chain analysis, "what if" scenarios, simulations, and stress test modeling
- Capital flows prediction, including refinancing and capital needs, as well as issuance forecasts and predictive cash flows
- Transaction optimization, including payments and money transfers, purchase of financial and nonfinancial products, order routing, matching, and surveillance
- New products, such as index funds or dynamic exchange-traded funds that offer proactive risk mitigation to underperforming, asset-volatile sectors and can capitalize on short-term market opportunities

Impact of agentic AI in financial markets

Agentic AI capabilities could offer significant opportunities for financial markets. Deep and wide analysis of information takes time, and increasing operational efficiency can improve productivity and save time for more value-added activities.

Deep and wide analysis of information takes time, and increasing operational efficiency can improve productivity and save time for more value-added activities.

Qualitative benefits such as error reduction, consistency and timeliness may similarly add value for practitioners and customers in financial services. Furthermore, agentic AI solutions can improve price discovery, such as adjusting prices in real time based on supply and demand changes, and generate timely predictions to optimize pricing strategies, expand revenue opportunities and improve transparency. By leveraging advanced algorithms and data analytics through well-orchestrated agentic AI systems, firms can make more informed decisions, respond swiftly to market changes and ultimately drive profitability in an increasingly competitive landscape.

However, we expect that agentic AI in finance will take time to gain scale, with challenges surrounding:

- **Financial stability risks:** AI agents' capacity to increase the complexity and opacity of workflows if not correctly managed, as well as their ability to execute transactions at high speed, means they can amplify systemic risks. Agentic AI systems interacting at scale may multiply the speed of execution and spread of contagion in situations of high volatility, disinformation, cyberattacks or market turmoil.

- **Regulatory concerns:** For use cases involving trading and investment advice, new products and systems can potentially affect financial stability (e.g., certain risk management and transaction optimization systems). These would most likely fall under the high-risk category of the EU AI Act and may be highly scrutinized by other regulators to ensure investor protection, transparency in decision-making and market integrity. Reporting requirements for counterparty credit risk exposures may need to become real-time instead of daily or weekly.

- **AI governance challenges:** The autonomous nature of agentic AI systems in handling confidential information and their potential to make mistakes, make unethical decisions and cause harm (e.g., through hacker AI agents) pose considerable risks in accountability and liability for market participants. AI governance is crucial to mitigate these risks through conscious design and oversight. We expect that financial players will be cautious when scaling agentic AI, as they are ultimately liable for their agents' misbehavior.

Furthermore, an adverse consequence of AI agents' operational speed and persistence may be reducing the natural latencies of traditional market mechanisms, potentially eliminating some investment opportunities and arbitrage and making some asset classes unprofitable. Guarding against this would require very thorough analysis and process design to promote true agency; this is largely uncommon in AI agents today because processes feeding the agents and managing their implications downstream lack causal foundations.

Innovations in crypto markets illustrate how AI agents could emerge as market participants

Automated trading is already a feature of financial markets, primarily in high-frequency trading, where bots are programmed to execute specific transactions based on narrowly defined parameters, such as price differences for a security across different exchanges. But autonomous AI agents would make investment decisions, learn from and adapt to their environment, and transact with each other in financial markets. The technology already exists today: AI agents are a rapidly developing phenomenon in crypto markets. At first glance, the use cases seem far removed from traditional financial markets, especially due to legal and regulatory obstacles, but the concepts illustrate what roles AI agents can play.

- **Broadening access to high-frequency trading tools:** In traditional markets, high-frequency trading is only accessible to specialized institutions with significant infrastructure and location advantages. In crypto markets, platforms have emerged that allow users to build their own AI agent that can transact on a blockchain. Anyone with sufficient technical knowledge can set up a bot to trade on a decentralized exchange. So far, much of that activity has taken place in highly speculative meme-coin markets. According to Blockworks Research data, trading bots have represented an average of 5% of daily trading volumes on decentralized exchanges on the Solana blockchain in 2025 so far.

- **Providing investment advice:** Large language models support chatbots that interact with users in plain English to tailor investment recommendations.

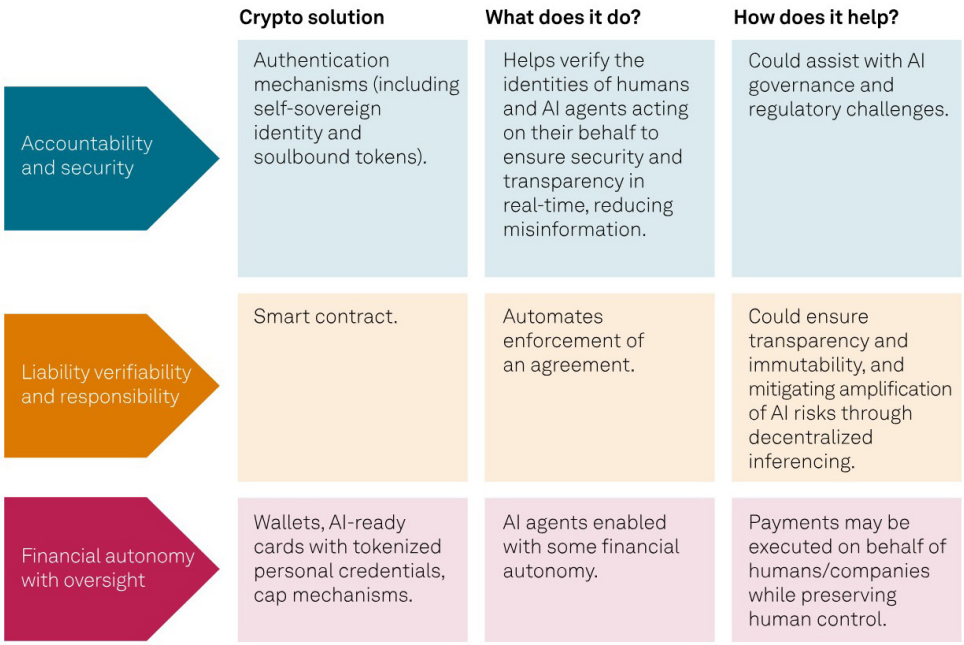
- **Executing transactions while removing technical knowledge barriers:** A major pain point for crypto users is the technical complexity of interacting with different blockchains and protocols. New user interfaces allow users to specify plain English instructions that an AI agent will then execute. This is the equivalent in traditional markets of calling a broker to place an order.

Crypto markets are an interesting testing ground for AI agents because they bring composability, or the ability to easily use the same asset across multiple platforms. This increases the scope in which an AI agent can operate and learn. The tokenization of financial assets will bring some of this composability to traditional markets; it is the parallel growth arcs of AI and blockchain technologies that may bring AI agents to parts of the financial markets.

Crypto technology brings some solutions to agentic AI paradigms

Crypto technology such as blockchain, thanks to its immutable and decentralized nature, helps provide solutions to agentic AI in finance and enhances transparency. AI-powered smart contracts, carefully engineered to avoid introducing vulnerabilities (e.g., prompt injection, model inversion and credential leakage), can automate complex processes and enhance efficiency. Furthermore, instant settlements for agent queries in smart contracts can facilitate multi-agent interaction and collaboration.

Agentic AI paradigms



As of May 2025.
Source: S&P Global.

Regulatory concerns will inevitably grow alongside development of AI agents and crypto solutions, and the blockchains that will likely provide the information infrastructure for them. AI agents could use wallet verification tools or soulbound non-fungible tokens (NFTs) to identify parties involved in a financial transaction, whether directly or via a custodial relationship. These identifiers could function in authentication and security operations. But they have vulnerabilities: While designed to mitigate security risk, they could instead amplify it and contribute to contagion if automated systems are unchecked, creating a vector for decentralized-finance-related cyberattacks. Examples include sybil attacks, routing attacks, logic errors (which could be amplified with agents), key theft/mismanagement and decryption of keys (e.g., quantum safe). Unsurprisingly, regulations and legal oversight are rapidly evolving in crypto technology as AI becomes more intertwined with decentralized systems.

Bridging the gap to the future

Several key developments are necessary to scale agentic AI applications across financial markets: increased transparency and explainability of agentic processes to build trust among market participants and regulators, adaptive real-time regulation both for AI and crypto technology to ensure accountability and liability, and the interoperability of data and infrastructure to power financial markets.

The future has never looked this precarious and bright at the same time, and agentic AI may play a key role in shaping this transformation. The disruptive and transformative effects of AI on the financial markets may be a double-edged sword, and as with any innovation of broad scale and utilization, it requires prudent management. The benefits it brings extend beyond efficiency and productivity, but its potential for inspiring further innovation and creativity — enabling and accelerating progress at a rate not seen before — is counterbalanced by its ability to amplify systemic risks of similar magnitude. This irreversible transition to AI in financial markets must be harnessed thoughtfully and responsibly by regulators and market participants alike. ■

This article was authored by a cross-section of representatives from S&P Global. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Private capital will play a pivotal role funding the future of infrastructure

Private credit has become an important source of funding for both the energy transition and infrastructure needed to enable technological advancements in capital markets.

Conway Irwin, Director, Climate and Cleantech
S&P Global Commodity Insights

Chris DeLucia, Director, Global Power and Renewables
S&P Global Commodity Insights

Kelly Morgan, Research Director, Datacenter Infrastructure
S&P Global Market Intelligence 451 Research

Michelle Ho, Associate Director, Private Markets Analytics
S&P Global Ratings

Highlights

Significant investments will be needed to fund the power and digital infrastructure needs of tomorrow. Private credit is carving out a niche as a bespoke funding source for this transformation.

Funding for energy infrastructure includes building new sustainable power sources to meet energy transition goals, as well as capacity to meet the massive power demands of new datacenters needed to run digital markets and enable technologies such as AI.

These complex, capital-intensive projects are often not well suited for traditional sources of funding. This is contributing to the growth of private credit, which offers a source of flexible, patient capital.

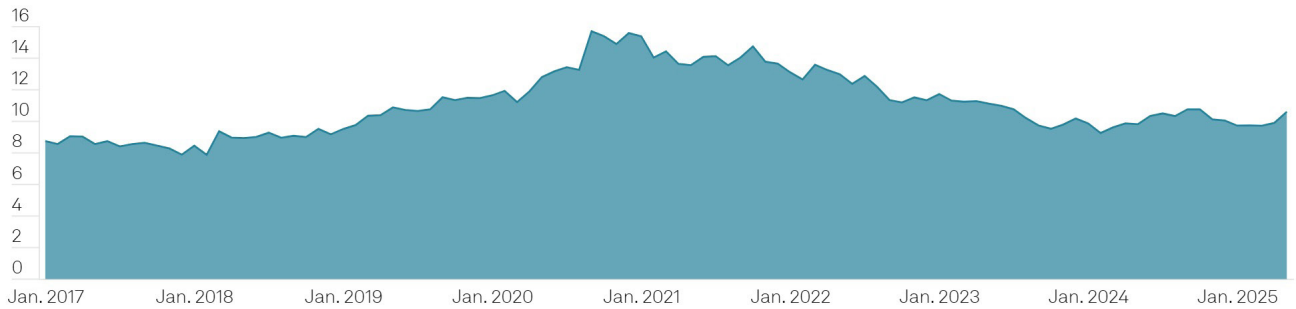
To fund the future of capital markets, considerable investment in infrastructure is required in the present. Datacenters, digital infrastructure and new power supply are needed to scale advancements such as tokenization and AI — critical tools that enhance efficiency and enable investors to navigate future markets. Ongoing funding is also needed to support the energy transition.

Because these early-stage technologies require large up-front capital investments and have long investment horizons, digital and energy transition infrastructure projects are often not a natural fit for traditional sources of funding. Instead, they may need bespoke funding solutions, where the speed of change and innovation driving these technologies is met by a similarly fast-changing funding mix. While banks have long been the key providers of infrastructure funding, financing methods have broadened to include a mix of public and private options. These options are also spreading beyond financing for the energy transition and digital markets and are gaining traction in the broader infrastructure market.

Public capital markets are a natural fit for more mature industries and technologies. As we have seen recently, uncertainty, volatility and cyclicality in public market sentiment may not align with the large-scale and long-term structural demands of tomorrow's infrastructure. For instance, demand has moderated for opportunities aligned with environmental, social and governance factors, after they received a surge of positive interest between 2020 and 2021. Equity market valuations show these swings in public market sentiment.

Global renewable generation companies

Equity market valuations (EV/NTM EBITDA)



Data compiled May 22, 2025.
EV = enterprise value; NTM = next 12 months.
Global renewable generation companies includes publicly traded companies worldwide with a market capitalization of at least $1 billion, for which operations either entirely pertain to or largely consist of development of, ownership of and/or investment in utility-scale wind and solar photovoltaic assets.
Sources: S&P Global Commodity Insights; S&P Global Market Intelligence.

Project finance is most commonly used to fund the construction and operation of capital-intensive assets — from wind farms and stadiums to datacenters — with debt serviced from the cash flows of completed projects and secured by collateral including project assets, and debt instruments that feature strong covenant packages and guarantees.

But private markets are also increasingly contributing to the supply of funding with asset-based finance, where investors are drawn by predictable, contractual cash flows, with returns that are not correlated to the broader markets. In part, this funding comes from a growing number of alternative asset funds dedicated to infrastructure that can offer more flexibility and customization for project financings. But for all their benefits, private credit instruments offer less liquidity and transparency than standardized public market instruments. The diverse pool of infrastructure investments and their added complexity may also contribute to fragmentation in private markets.

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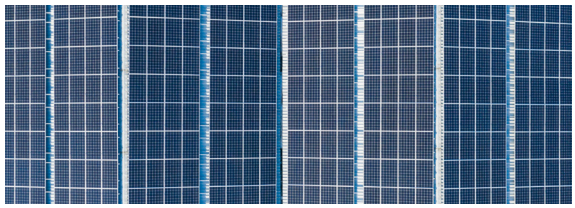


Private credit carves out a niche in cleantech, energy transition financing

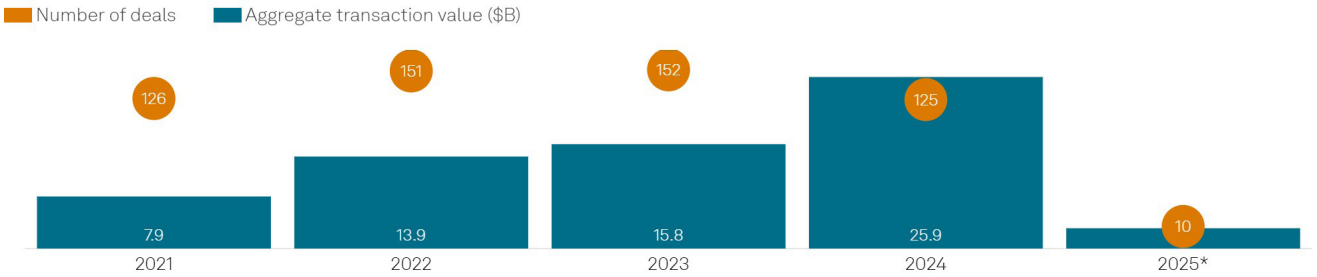
Private credit has become vital in providing flexible, patient capital for the energy transition as interest in these projects has intensified.

S&P Global analysts noted a surge of private credit infrastructure lender activity in the energy transition sector following the COVID-19 pandemic and supply chain disruptions, when energy transition projects attempting to raise project financing from banks faced sectoral headwinds due to rising interest rates, tighter lending standards and uncertain market outlooks. Tailwinds for the sector, including declining input costs and strong policy support — particularly in the US and EU — bolstered potential returns for these projects, but many still fell outside the parameters of banks' traditional lending portfolios.

Private credit funds compensated for much of the funding shortfall in the US, sometimes in partnership with bank lenders, and backed dozens of smaller debt deals or existing asset acquisitions that reflected the smaller-dollar project economics of many renewable energy investments. These deals reflected a shift in debt financing capacity to private markets, which has filtered its way into project financing.

Global private equity and venture capital-backed investments in renewable energy have risen steadily since the beginning of the decade in terms of number of deals and aggregate deal value. Private credit's share in aggregate energy transition financing has fluctuated over the past few years, but this has been driven more by changes in bank commitments — which expanded in 2024 amid a broad push to build out clean technology lending capacity — than by any pullback in private credit to the sector.

Global PE/VC-backed investments in renewables, 2021–2025



Data compiled March 12, 2025.
PE/VC = private equity or venture capital.
*Year to date through Feb. 28, 2025.
Analysis includes global whole-company acquisitions, minority stake acquisitions and asset acquisitions, and rounds of funding announced between Jan. 1, 2021, and Feb. 28, 2025, where the buyer/investor in the deal is or includes a private equity or venture capital firm, and where the target's primary industry is classified by S&P Global Market Intelligence as renewables.
Excludes terminated deals and add-on acquisitions.
Source: S&P Global Market Intelligence.

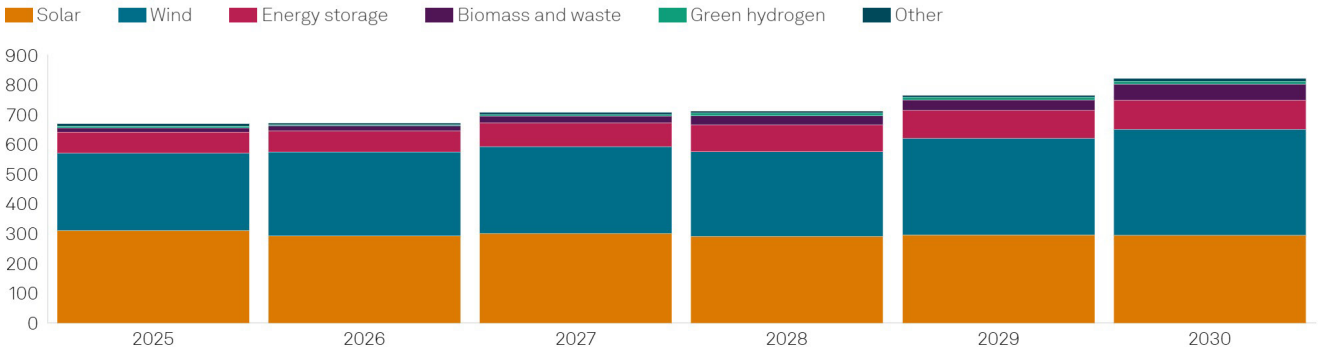
This chart is specific to renewables and understates the breadth of private capital inflows into broader energy transition investments in renewable energy. Beyond renewable investments, there has been a surge of interest over the past five years in biogas, biofuels and carbon-removal solutions such as direct air capture. With rapidly changing technology and innovative approaches, classifying energy transition projects is a challenge. Energy investments were once easily bifurcated into the categories of fossil fuels and low-carbon, but energy transition-related projects can increasingly be found within the categories of gas, batteries and lower-carbon liquid fuels, in addition to renewables.

The requirements and best mechanisms for financing these technologies are varied. Private credit's capacity to offer greater flexibility in structuring loans and creating other forms of bespoke financing is a compelling option for cleantech developers, despite higher borrowing costs than traditional bank lending. This is particularly true for projects that fall outside of the scope, size, risk parameters or financial standardization most attractive to traditional banking.

The most-adopted technologies — solar photovoltaic and battery storage — are inexpensive, well understood in many markets and growing at rates that provide fundamental proof of their value proposition as a source of new electricity generation. But from a financing perspective, the scalability that makes these technologies suitable to a wide range of applications — from 10 panels on a rooftop with a battery pack in the garage to a football field-sized, utility-scale installation — puts many developments outside the scope of ordinary bank lending, project financing or infrastructure finance.

Over $4 trillion in cleantech investment is needed through 2030 ($B)

Estimated investments in clean energy capacity



Data compiled May 16, 2025.
Solar includes photovoltaic and concentrated solar power; wind includes onshore and offshore; other includes geothermal, ocean, and carbon utilization and storage.
Source: S&P Global Commodity Insights.

Despite recent policy shifts in the US, indications from the private sector point to a continued appetite for cleantech and other energy transition investments. New private capital funds are continuing to target this play, including a $5.6 billion energy transition-focused private equity fund raised by Blackstone in February 2025. Institutional investors are continuing to pursue decarbonization mandates, sometimes using different terminology, effectively mitigating some of the lending risk for private debt funds.

The need to continue financing capital-intensive projects in clean energy and transition-related infrastructure comes amid rising demand for energy to power the digital infrastructure of AI. The power needs for this cloud computing and datacenter infrastructure are more weighted toward electricity than hard-to-displace liquid fuels, providing opportunities for private credit to step in.

The need to continue financing capital-intensive projects in clean energy and transition-related infrastructure comes amid rising demand for energy to power the digital infrastructure of AI.

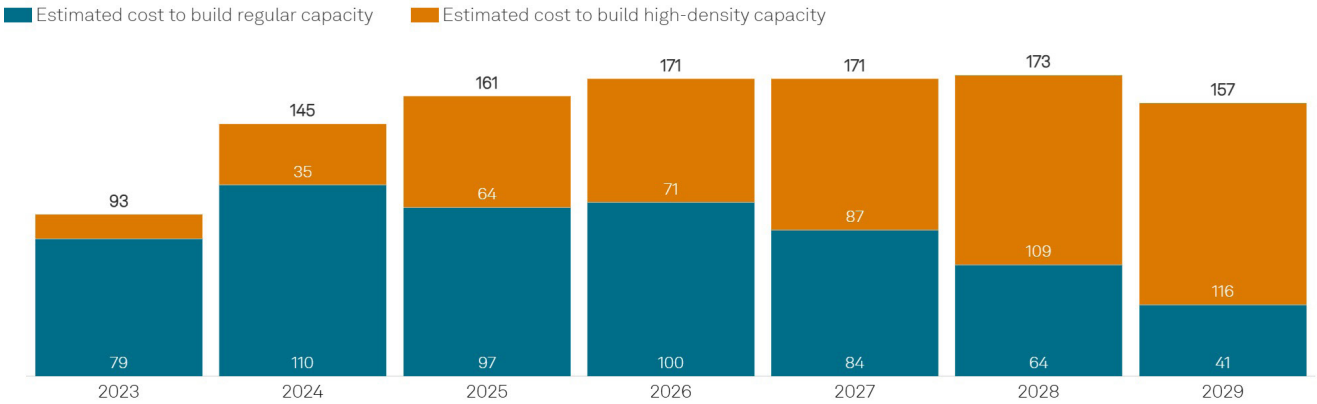
Datacenters: A case study in bespoke financing

AI tools will be essential for capital markets to help manage the additional complexity and fragmentation of an increasingly digital space and instruments that are increasingly bespoke. To scale AI will require substantial computing power from datacenters and hyperscalers. The pace of technological innovation and the demand for AI have presented enormous opportunities for financing the development of digital infrastructure. Datacenters have seemingly become an essential investment across many public and private equity portfolios due to their growth potential and potential for stable contractual cash flows. We expect global infrastructure funding and financing requirements for datacenters to rise 86% to $173 billion by 2028 from $93 billion in 2025.

Datacenters may be privately or publicly funded. Advanced economies are more experienced in building and running datacenters, but emerging economies are becoming a target development area. Each region has different funding access across traditional banking lenders, sovereign capital and private markets. In some markets, sustainability-linked or green bonds could play an important role, notably to fund green initiatives that aim to increase datacenter energy efficiency or provide renewable energy solutions.

As projects multiply and average project sizes increase, constraints across power and water requirements, financing, tenant concentration and cost inflation will emerge. The substantial resources needed for such innovative and transformational projects are also bringing new investors, including those that may have a higher risk tolerance.

Global spend required each year to build datacenters ($B)



Estimate as of March 2025.
Source: S&P Global Market Intelligence 451 Research.

Private credit is emerging as a prominent financing source for datacenter infrastructure by providing flexible capital solutions. Offering the prospect of steady inflation-resistant cash flows and higher returns, alternative asset managers are flocking to incorporate datacenter projects into their portfolios. Life insurers, particularly annuity providers, are playing an increasingly central role as investors in several alternative asset managers' lending platforms, as the long-term liabilities of insurers can be matched to long-duration assets.

For borrowers, private funding is more fungible for commercial bank funding than bond markets. In reviews of public and private finance transactions, S&P Global Ratings observed that private placement issuances among rated datacenter entities were faster than public bond transactions.

> Datacenters have seemingly become an essential investment across many public and private equity portfolios due to their growth potential and potential for stable contractual cash flows.

Because fewer parties are involved, private funding offers more certainty when it comes to execution, speed, flexibility, pricing and terms. These hallmarks of direct origination through private funding benefit borrowers as they provide tailored maturities, covenants and terms. This is critical, considering how datacenter infrastructure projects can have widely varying needs over their useful economic lives.

Public credit retains a foothold in energy transition funding

Even as private markets are establishing their place in infrastructure and energy transition funding, public capital markets retain an important role that we do not expect private markets will fully supplant. For instance, companies that are in the low-carbon segment and those in the process of decarbonizing their portfolios commonly rely on public markets for funding.

From a capital structure standpoint, both public equity and fixed income contribute to funding these investments. With a generally lower cost of capital, public debt remains a preferred mechanism for financing more mature industries and technologies. Since early 2020, electric utilities worldwide have issued over $900 billion of senior and preferred debt, according to data from S&P Global Market Intelligence. Much of this funding has been allocated to decarbonizing power generation portfolios and building grid infrastructure amid a broader trend toward electrification. Meanwhile, becoming publicly traded remains a key objective for many companies in the low-carbon sector as they seek a stable component of capital while preserving balance sheets. Nearly 50 renewables-focused companies worldwide have completed IPOs of

meaningful size so far this decade, raising approximately $14 billion in total proceeds. New instruments — such as ESG-focused mutual and exchange-traded funds, green bonds and sustainability-linked financing — have emerged to support companies with a low-carbon emphasis. These instruments can lower the cost of capital and increase accessibility for issuers while catering to a broader range of investors.

With a generally lower cost of capital, public debt remains a preferred mechanism for financing more mature industries and technologies.

At the same time, public markets can be ill-suited for the financing required to support the energy transition, and market sentiment can quickly shift. Public markets are largely centered on relatively mature and understood businesses, with IPOs generally limited to companies with a line of sight to profitability. Early-stage technologies — some of which are expected to play an important role in accelerating the energy transition — may need more creative problem-solving to unlock their value than public markets are willing to provide.

Geopolitical considerations and the need for energy transition capital in emerging markets add to the complexity of financing needs as these regions are often fragmented, at different stages of growth and maturity, have less supporting infrastructure, and are more exposed to currency fluctuations and political risks.

Energy transition projects or strategies may take a decade or more to execute, and public investors may not have the patience to overlook short-term considerations. In these situations, private market investors that can withstand longer investment horizons may be more compatible with the intricacies and demands of a project.

Today's financing lays the foundation for tomorrow's innovations

From the ground up, infrastructure projects provide the foundation for the businesses and capital markets of tomorrow. Connecting market participants through advanced blockchain technologies and AI requires building digital infrastructure today. Furthermore, the future of digital markets is electric, requiring power and new energy sources. The new technologies, complex risks and long-term horizons involved in such infrastructure investment may not suit existing public markets, creating an opportunity for private credit to become a key driver of funding. ■

This article was authored by a cross-section of representatives from S&P Global. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Exchange-traded funds: Expanding access to finance's future

Crypto ETFs and private credit ETFs provide a point of entry to new assets using the existing infrastructure of financial markets.

Evan Gunter, Director, Lead Research Analyst, Private Markets Analytics
S&P Global Ratings

Tom Schopflocher, Managing Director, Structured Finance Research
S&P Global Ratings

Maya Beyhan, Ph.D., Senior Director, Index Investment Strategy
S&P Dow Jones Indices

David Easthope, Head of Fintech
Crisil Coalition Greenwich

Michelle Ho, Associate Director, Private Markets Analytics
S&P Global Ratings

Highlights

As private credit and tokenization enable the transformation of capital markets, access remains a barrier to entry for many investors.

Exchange-traded funds (ETFs) offer a point of entry to new assets by providing a wrapper that simplifies purchasing through an exchange, using the existing infrastructure of financial markets.

Despite their allure, financial innovations can introduce new risks and complexities for investors. Part of the appeal of a crypto ETF or private credit ETF is the ease of access and liquidity for trading, but this can result in a mismatch when the underlying asset is less liquid.

ETFs are a well-known investment vehicle and have proven their adaptability over time. Changes, both within markets and from external factors, bring risk. While investors can access new types of assets through crypto ETFs and private credit ETFs through a vehicle that relies on the existing financial market infrastructure, this could lead to complications because of a lack of liquidity.

ETFs can accommodate different assets

As capital markets evolve, nascent assets initially may be less accessible or difficult to trade. A broader range of private credit and crypto assets presents various challenges to accessibility and liquidity, but they are increasingly integrated into portfolios through the traditional financial infrastructure within an ETF wrapper.

ETFs of collateralized loan obligations (CLOs) may be an instructive example of how financial innovations can gain traction. CLOs were an established financial asset for nearly 30 years prior to the creation of the CLO ETF. But within two years of the launch of the first CLO ETF, the total assets under management within the ETF market had increased tenfold to $30 billion, giving ETF managers sufficient scale to anchor some recent CLO transactions themselves.

ETFs offer the flexibility to adapt to new trends and investment themes by holding baskets of underlying assets that can be bought and sold on an exchange. This structure can provide diversification for investors and simplify the purchasing process through a public exchange.

ETFs can provide a point of entry for investors to new assets

	CLO ETFs	Crypto ETFs	Private credit ETFs
Assets under management	$30 billion	$121 billion	$0.11 billion
Growth since Q1 2024	2.3x	1.9x	NA
Assets account for	3% of CLO market	4.6% of cryptocurrency market	<0.01% of private credit market
Number of funds	20+	30+	2+

As of May 2025.
NA = not available; CLO ETF = exchange-traded fund that invests in collateralized loan obligations.
Sources: S&P Global Dow Jones Indices; Lipper LSEG; S&P Global Ratings Private Markets Analytics.

Despite their allure, financial innovations introduce new risks and complexities for investors. Not all innovations achieve success, and not all financial products are broadly suitable. Some may carry new or unknown risks, and ETF investments can vary in fundamental ways, making those risks far less transparent. In other words, investors should take a closer look at the fine print.

Despite their allure, financial innovations introduce new risks and complexities for investors. Not all innovations achieve success, and not all financial products are broadly suitable.

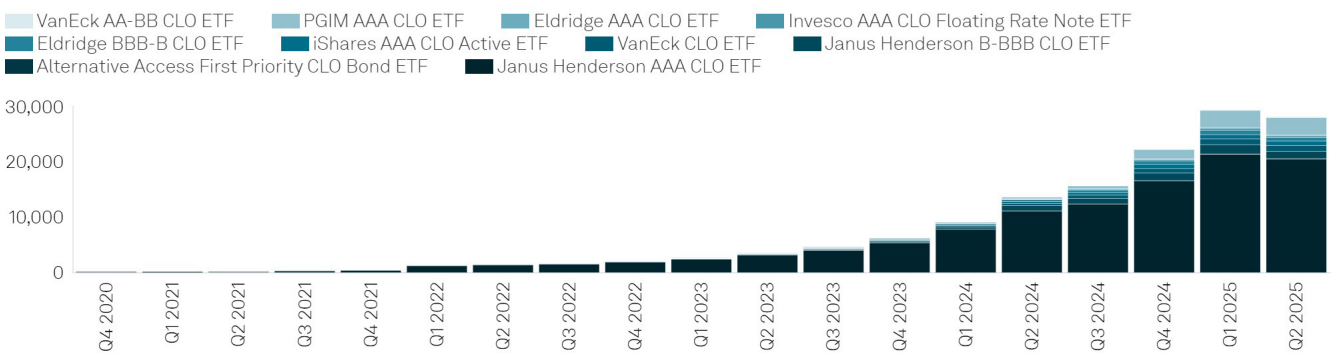
The overnight success of CLO ETFs

CLOs have been around for over 30 years, establishing a solid track record through multiple credit cycles while serving a narrow, traditional investor base of large banks and insurance companies.

The first CLO ETFs were launched in 2020 and grew rapidly, doubling or even tripling in value quarter over quarter since 2023, reaching $30 billion in AUM as of the first quarter of 2025. These funds injected new liquidity into CLO primary and secondary markets, with demand catching on among retail investors.

CLO ETF growth swiftly went exponential

Assets under management of select CLO ETFs ($M)



Data compiled May 7, 2025.
CLO ETF = exchange-traded fund that invests in collateralized loan obligations.
Sources: Bloomberg; S&P Global Ratings.

The largest CLO ETFs, such as Janus Henderson's JAAA, typically focus on the AAA tranches of CLOs of broadly syndicated loans, which represent the more liquid segment of the CLO market. However, the market is broadening: Newer funds are targeting either mezzanine (or BBB) tranches of broadly syndicated CLOs or senior tranches of middle-market CLOs, which invest in private credit loans.

Although ETFs own just roughly 3% of the US CLO market, the largest CLO ETFs already anchor some new CLO issues in the primary market. This influx of demand from ETFs for CLOs appears to be lowering the cost of funding for new CLOs.

While ETF ownership is typically under 10% of the outstanding CLO tranche balance, it is not uncommon for ETFs to own between 10% and 30% of a tranche. For a CLO with substantial ETF ownership, these funds may provide a stable source of liquidity, price transparency and higher routine trade volume for CLO notes in the secondary market.

This influx of demand from ETFs for CLOs appears to be lowering the cost of funding for new CLOs.

Liquidity considerations for CLO ETF investments

CLO tranches can be traded, but volume is thin compared to shares of an equity ETF, such as SPY. While this creates a liquidity mismatch between the underlying assets and the ETF, the ETF structure is designed to mitigate this risk.

The ETF structure differs from that of an open-ended mutual fund, which must meet redemption requests from investors, potentially leading to asset sales. ETFs face no such obligation to sell portfolio assets, as investors simply sell shares on the exchange when they seek to liquidate a position.

However, this can lead to situations where the price of the ETF may move more quickly than that of the underlying assets. In such cases, the ETF's share price can deviate from its net asset value (NAV) per share. Open-ended mutual fund shares, on the other hand, will reprice to the NAV at the end of each trading day.

ETFs are not required to rectify this price/NAV mismatch, which is measured as a premium or a discount. Typically, disparities between an ETF's share price and its underlying portfolio value are arbitraged by secondary market investors' opportunistic trading of the ETF shares and the ability of authorized participants to create or redeem ETF shares. These market-balancing actions tend to drive NAV per share and the ETF's share price toward parity.

CLO ETFs face market challenges

CLO ETFs faced their first test of resilience in April 2025, during the volatility following the US government's tariff announcements. Outflows from CLO ETFs surged to nearly 10% of their total AUM in the four weeks to April 16, 2025.

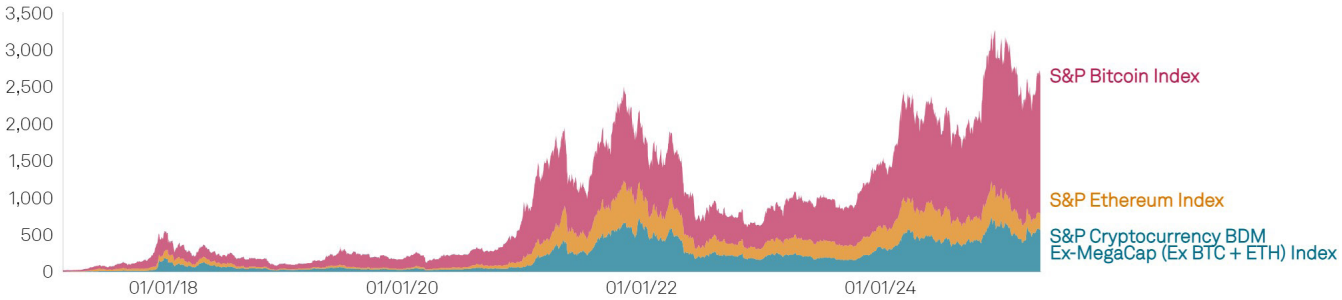
During this volatile period, some of the larger AAA CLO funds traded at discounts of 1% to 1.5% below NAV, while less-liquid mezzanine or private credit CLOs traded at discounts of 4% to 6%. In almost all cases, however, these discounts swiftly dissipated by the month's end as markets stabilized and inflows resumed.

Crypto ETFs emerge

Cryptocurrencies first appeared with the launch of bitcoin in 2009, creating a decentralized ledger system using blockchain technology. This innovation revolutionized the way individual transactions can be executed by removing the need for intermediaries such as banks or financial institutions. Although the journey has not been smooth, today most investors recognize cryptocurrencies as an asset class, held in the portfolios of retail and institutional investors alike.

Bitcoin and ethereum are the largest cryptocurrencies, together representing over 75% of the $2.5 trillion market cap of the broader digital market.

Led by bitcoin, the broad digital market exceeds $2.5 trillion in market cap ($B)



Data as of March 31, 2025.
Chart is based on index market capitalization in US dollars. The S&P Bitcoin Index was launched on May 3, 2021. The S&P Ethereum Index was launched on May 3, 2021. The S&P Cryptocurrency Broad Digital Market Index was launched on July 13, 2021. The S&P Cryptocurrency BDM Ex-MegaCap Index was launched on July 13, 2021. All information for an index prior to the launch date is back-tested hypothetical data. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this article for more information regarding the inherent limitations associated with back-tested performance.
Source: S&P Dow Jones Indices.

As institutional interests and trading volumes increase, and with an expanding mix of assets and platforms, the need for more robust market infrastructure becomes more pressing.

Crypto ETFs create an elegant solution to investor challenges

According to research from Crisil Coalition Greenwich, demand for institutional-grade, institutionally focused markets and technology infrastructure for crypto trading has ballooned in recent years, bringing new opportunities and challenges.

One key concern for crypto investors and traders is slippage, which occurs when the price moves against the trader when they try to buy or sell larger orders. Although digital markets have round-the-clock trading and instant settlement capabilities, they often lack the depth of liquidity for large trades due to the nascent nature of some assets and market fragmentation.

Another concern is information leakage, particularly in the case of public blockchains on which transactions can be monitored in real-time. This includes monitoring activity around the largest institutional crypto wallets. Counterparty risk is another key concern because some exchanges are lightly regulated and the custodian rules that apply to traditional assets are much different for crypto assets, necessitating enhanced technology support and security.

Investors — particularly those who do not want or need to own these assets directly — can turn to the familiar and increasingly popular ETF, whose structure allows them to gain crypto exposure.

New venues to trade crypto are emerging, including, potentially, nationally regulated venues such as exchanges and alternative trading systems. At the same time, investors — particularly those who do not want or need to own these assets directly — can turn to the familiar and increasingly popular ETF, whose structure allows them to gain crypto exposure. In many ways, the crypto ETF structure addresses the challenges faced by institutions that wish to buy, hold or sell crypto easily.

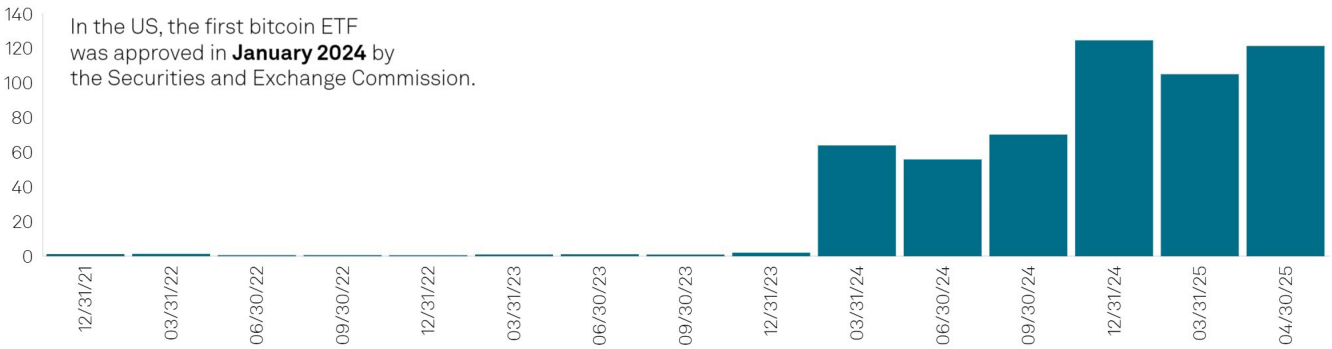
The first spot bitcoin ETF in the US was approved by the Securities and Exchange Commission in January 2024, although earlier bitcoin-focused funds, trusts and exchange-traded products date back to 2021. The response to, and popularity of, the first bitcoin ETF was overwhelming, unlocking the market. Since then, investor inflows into crypto ETFs have been very strong.

The AUM of crypto ETFs more than doubled from the end of the first quarter of 2024 to year-end 2024, surpassing $120 million. However, this growth has been volatile.

The simple point-and-click ease of trading an ETF, such as via an online brokerage account, brought major accessibility improvements to the markets. First, it offers a simple buy-and-sell experience through established channels. Second, and most importantly for institutions, trading shares of an ETF means the custody of the underlying asset is managed by

Investor inflows into crypto ETFs surge after approval of 1st spot bitcoin ETF

Crypto and digital asset ETF assets under management ($B)



As of May 2025.
ETF = exchange-traded funds. Shows assets under management of crypto ETFs, excluding short-interest funds.
Source: S&P Global Ratings using data supplied by Lipper LSEG.

a well-established technology provider. Investors do not have to manage self-custody or trust an exchange-based custody approach. ETFs provide a simple wrapper that allows investors to trade crypto exposures listed on a regulated exchange, through an established broker relationship where they can benefit from the existing infrastructure, including tax reporting, and through the plumbing of traditional financial markets.

The digital market continues to see a rapid proliferation of altcoins, stablecoins, DeFi tokens, meme coins and other tokenized assets. Moving forward, crypto ETF issuers are targeting Ripple, Solana and even some meme-coin assets, with multi-asset ETFs also in the mix.

Private credit ETFs could expand the investor base

Private markets offer a large pool of diverse investments, yet they attract little retail investment. In the US alone, the mass-affluent and middle markets, representing more than 40 million households, hold over $21 trillion in investable assets. Despite the established presence of alternative assets, which account for 10%-15% of global assets and are growing, mass-affluent investors allocate less than 1% of their portfolios to private markets.

The US has over $21 trillion in investable assets among the mass-affluent and middle markets, representing more than 40 million households

Wealth tier	Number of households (thousands)	Total investable assets ($B)
Ultra-high net worth (>$20M)	284.2	13,142
High net worth ($10M–$20M)	486.9	6,676
Wealth market ($5M–$10M)	1,578.6	10,949
Affluent market ($2M–$5M)	3,885.4	12,139
Mass-affluent market ($0.5M–$2M)	15,566.7	15,260
Middle market ($0.1M–$0.5M)	26,951.3	6,280

Data compiled 2023.
Source: Cerulli Associates, The Cerulli Report US High-Net-Worth and Ultra-High-Net-Worth Markets 2023: The Evolution of Service Delivery. Table is provided for illustrative purposes only.

Access to alternative assets such as private credit has traditionally been limited to high net worth, qualified and institutional investors. While recent launches of nontraded business development companies and interval funds are marketing to a broader mix of affluent retail investors, index-based solutions may facilitate a broader distribution of private credit to a larger retail market through ETFs.

Compared to crypto ETFs, private credit ETFs are still in their early days. Only a handful have been launched thus far, including the SPDR SSGA Apollo IG Public & Private Credit ETF (PRIV) and the Virtus Private Credit Strategy ETF (VPC), which target private credit broadly. Others have approached the market with a focus on private credit CLOs or business development companies.

In the portfolios of existing private credit ETFs, including PRIV and VPC, much of the collateral consists of investment-grade credit, including US Treasurys and agency debt, business development companies, nonbank financial lenders, and securitized assets such as CLOs.

Notably, the recently launched PRIV from State Street and Apollo plans to allocate between 10% and 35% of the fund's portfolio to private credit, which may exceed the regulatory limit of 15% for illiquid investments. Apollo navigated this roadblock by contractually agreeing to provide executable intraday bids on all investments it originates that PRIV will hold, and to buy back private credit assets where required, essentially making and underwriting the market.

This raises questions about the availability of redemption requests on demand. It remains to be seen whether this much-needed solution, which addresses the inherent liquidity mismatch, will endure. However, by providing a liquid wrapper around an illiquid investment, this private credit ETF meets rising demand from retail investors for entry to a market typically accessed only by institutional investors.

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ETFs introduce a new route for price discovery in private credit, addressing concerns of transparency. Because ETFs are traded at scale on public exchanges, their volume can easily outpace that of the underlying loan assets, which could lead to premiums or discounts to NAV of the private credit ETF.

Certain characteristics of private credit and alternatives suggest that these assets may not be a good fit for all investors. Private credit and other alternatives have been limited to certain groups of qualified investors because the underlying assets often have limited secondary market activity and complex instruments; these assets also lack liquidity and the same depth of transparency as assets in public markets. Risks associated with new financial innovations can be high and are often complex to evaluate.

Connecting to the future of capital markets

Markets naturally change and adapt, disrupt and evolve. CLO ETFs may provide an instructive example of how adoption of a new asset can move slowly but then rapidly gain momentum. We expect the future to bring ever more innovation and newer asset classes to market. The variety of assets in private credit and crypto is proliferating, with new and varied instruments emerging. While investors may face technical or other hurdles in accessing new assets, ETFs can provide a familiar wrapper for unfamiliar assets, such as in crypto ETFs and private credit ETFs. Innovations and new technologies such as private credit and tokenization may be creating the infrastructure for the future of capital markets, and some of the building blocks of this future already sit in the ETF portfolios of today. ■

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Performance disclosure

Please refer to the methodology for any particular index for more details about that index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

S&P Dow Jones Indices defines various dates to assist our clients in providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the index is set to a fixed value for calculation purposes. The Launch Date designates the date when the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P Dow Jones Indices defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its data feed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

All information presented prior to an index's Launch Date is hypothetical (back-tested), not actual performance. The back-test calculations are based on the same methodology that was in effect on the index Launch Date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. Complete index methodology details are available at www.spglobal.com/spdji/en. Past performance of the Index is not an indication of future results. Back-tested performance reflects application of an index methodology and selection of index constituents with the benefit of hindsight and knowledge of factors that may have positively affected its performance, cannot account for all financial risk that may affect results and may be considered to reflect survivor/look ahead bias. Actual returns may differ significantly from, and be lower than, back-tested returns. Past performance is not an indication or guarantee of future results. Please refer to the methodology for the Index for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations. Back-tested performance is for use with institutions only; not for use with retail investors.

Typically, when S&P DJI creates back-tested index data, S&P DJI uses actual historical constituent-level data (e.g., historical price, market capitalization, and corporate action data) in its calculations. As ESG investing is still in early stages of development, certain datapoints used to calculate S&P DJI's ESG indices may not be available for the entire desired period of back-tested history. The same data availability issue could be true for other indices as well. In cases when actual data is not available for all relevant historical periods, S&P DJI may employ a process of using "Backward Data Assumption" (or pulling back) of ESG data for the calculation of back-tested historical performance. "Backward Data Assumption" is a process that applies the earliest actual live data point available for an index constituent company to all prior historical instances in the index performance. For example, Backward Data Assumption inherently assumes that companies currently not involved in a specific business activity (also known as "product involvement") were never involved historically and similarly also assumes that companies currently involved in a specific business activity were involved historically too. The Backward Data Assumption allows the hypothetical back-test to be extended over more historical years than would be feasible using only actual data. For more information on "Backward Data Assumption" please refer to the FAQ. The methodology and factsheets of any index that employs backward assumption in the back-tested history will explicitly state so. The methodology will include an Appendix with a table setting forth the specific data points and relevant time period for which backward projected data was used.

Index returns shown do not represent the results of actual trading of investable assets/securities. S&P Dow Jones Indices maintains the index and calculates the index levels and performance shown or discussed but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. As a simple example, if an index returned 10% on a US $100,000 investment for a 12-month period (or US $10,000) and an actual asset-based fee of 1.5% was imposed at the end of the period on the investment plus accrued interest (or US $1,650), the net return would be 8.35% (or US $8,350) for the year. Over a three-year period, an annual 1.5% fee taken at year end with an assumed 10% return per year would result in a cumulative gross return of 33.10%, a total fee of US $5,375, and a cumulative net return of 27.2% (or US $27,200).