STATE STREET

NAVIGATING DEEPSEEK'S DISRUPTION

Opportunities and challenges in AI advancement

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Executive summary

DeepSeek, an artificial intelligence (AI) startup backed by Chinese hedge fund High-Flyer, is redefining AI's competitive landscape through a breakthrough in cost-efficient model training and inferencing.

Unlike traditional AI development, which relies on expensive hardware and data-intensive computation, DeepSeek has introduced a more efficient approach that reduces costs while maintaining high performance. This innovation has profound implications for financial institutions, policymakers and global markets.

By making AI more affordable and accessible, DeepSeek challenges the dominance of established firms and accelerates the technology's broader adoption. Its open-source framework and advanced learning methods could transform financial services, lowering operational expenses and enhancing capabilities in trading, risk management and regulatory compliance. However, regulatory scrutiny and geopolitical tensions may limit direct adoption in Western markets, prompting financial institutions to seek alternative ways to replicate these efficiencies.

DeepSeek's emergence also raises questions about the effectiveness of US trade restrictions on China, as China's ability to develop advanced AI despite external constraints reveals potential gaps in Western efforts to limit Chinese technological progress. If scalable, this technology could shorten AI innovation cycles, intensify competition and lower barriers to entry. While greater efficiency may reduce costs, history suggests it could also lead to broader AI adoption and increased investment, reshaping capital flows and market dynamics.

Beyond technological disruption, DeepSeek signals a structural shift in the AI economy, with far-reaching consequences for investment strategies, regulatory landscapes and global competitiveness. Institutional investors must assess how this evolving ecosystem could impact financial markets and the future of AI-driven industries.

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Introduction

DeepSeek has emerged as a disruptive force in AI, fundamentally altering the competitive landscape.

Its core innovations — cost-efficient AI training and inferencing, open-source licensing, and reinforcement learning-based reasoning — challenge prevailing AI development paradigms.

DeepSeek's efficiency-driven approach not only redefines AI's technological trajectory, but also has far-reaching implications for global economic structures and financial services. This article examines DeepSeek's impact from three dimensions:

- The competitive transformation of AI
- The economic and geopolitical consequences of its efficiency model
- The implications for global financial services

AI development has long been dominated by the assumption that larger models, trained with immense computational resources, consistently outperform smaller, less data-intensive approaches. DeepSeek fundamentally challenges this notion by achieving comparable results to those of industry leaders — such as OpenAI and Google — at a fraction of the cost. The company's innovative approach to AI model training and deployment has enabled it to develop state-of-the-art systems while significantly reducing computational expenses, representing a paradigm shift in AI economics. These advances force a reevaluation of the fundamental cost structures that have defined AI development over the past decade and raise questions about the long-term sustainability of dominant players' current AI business models (Zhang, 2025).

The company's innovative approach to AI model training and deployment has enabled it to develop state-of-the-art systems while significantly reducing computational expenses, representing a paradigm shift in AI economics.

The competitive transformation of AI

DeepSeek's innovation: Pioneering efficiency-driven AI

DeepSeek has introduced several significant innovations that differentiate it from traditional AI development approaches. Its breakthroughs in cost-efficient training, reliance on open-source methodologies and architectural advancements have profoundly impacted the AI ecosystem. One of its most notable achievements is the radical reduction in training costs. Unlike major AI firms in the United States that spend more than US$100 million to develop large language models (LLMs), DeepSeek reportedly trained its flagship R1 model for approximately US$5.6 million.[1] This drastic reduction in development cost is the result of optimized model architectures and strategic hardware choices as summarized in Exhibit 1.

Instead of relying on cutting-edge graphics processing units (GPUs) — which are not only expensive, but also subject to US export restrictions — DeepSeek has effectively leveraged widely available, older GPUs such as Nvidia's H800 series. This optimization not only makes AI training substantially more cost effective, but also allows DeepSeek to sidestep regulatory constraints on China's access to the latest AI hardware (Bhidé, 2025).

A key aspect of DeepSeek's efficiency lies in its model architecture, particularly its adoption of the Mixture of experts (MoE) approach. This framework optimizes computation by only activating those parts of the model necessary for the specific tasks at hand, significantly improving efficiency. By contrast, conventional AI models activate all parameters indiscriminately, leading to higher resource consumption. DeepSeek's MoE framework substantially reduces computational overhead without sacrificing performance, allowing smaller firms and researchers to access high-performance AI at a fraction of the cost previously required (Acemoglu, 2025).

Beyond architectural innovations, DeepSeek has also pioneered reinforcement learning-based training methodologies to further enhance efficiency. Unlike traditional models that rely heavily on human-annotated data for fine tuning, DeepSeek's system minimizes human intervention by leveraging automated reinforcement learning. This self-optimizing process enables the AI to learn iteratively without the need for extensive human feedback, reducing both the time and cost of model refinement.

Additionally, DeepSeek's focus on open-source development fosters greater transparency and collaboration within the AI research community. By releasing its models under a Massachusetts Institute of Technology (MIT) open-source license, DeepSeek challenges the longstanding dominance of closed, high-cost AI ecosystems, thereby opening new pathways for accessible and collaborative innovation (Zhang, 2025).

Exhibit 1: Summary of DeepSeek's innovation

Mixture of experts (MoE) architecture

DeepSeek's model employs MoE architecture, selectively activating only the necessary parts of the AI model for a given task. This modular approach drastically reduces computational resource consumption, resulting in significant cost savings.

Hardware optimization

DeepSeek optimized its model to function efficiently on readily available Nvidia H800 GPUs. These GPUs, while less powerful than H100s or A100s favored by other companies, are more accessible and affordable, contributing to DeepSeek's cost effectiveness. Additionally, DeepSeek utilized parallel-thread execution (PTX), a low-level programming language, to fine-tune AI-GPU interactions. This optimization allows them to extract maximum performance from the H800 GPUs, further enhancing efficiency.

Model distillation

DeepSeek leverages model distillation: a process in which a large, complex model (the *"teacher"*) trains a smaller, more efficient model (the *"student"*) while retaining much of the original model's intelligence. This technique reduces computational demand, making AI models cheaper and faster to deploy.

Reinforcement learning

DeepSeek employs reinforcement learning techniques to automate large portions of the model training process. This substantially reduces reliance on expensive and time-intensive human fine tuning, accelerating development cycles and lowering costs.

How DeepSeek used export controls to its advantage

In October 2022, the US imposed export controls on high-end GPUs destined for China, targeting chips that met or exceeded performance benchmarks akin to Nvidia's A100. These restrictions capped key performance metrics: First, compute power — as measured in floating point arithmetic operations (FLOPS) — was limited to roughly 300 teraflops (10^{12} FLOPS) in FP16 mode, while interconnect bandwidth was restricted to 600 gigabytes per second.[2] In October 2023, the US updated these restrictions, introducing direct caps on "total processing performance" regardless of interconnect speed. This led Nvidia to quickly pivot to its "H20" chips, which sacrifice compute power while preserving high bandwidth and expanding memory capacity — a crucial factor for state-of-the-art AI models. While memory capacity was not directly limited, these controls effectively forced Chinese companies to forgo state-of-the-art chips for large-scale AI training, aiming to impede China's ability to rapidly develop advanced AI models.

Confronted with these constraints, DeepSeek was compelled to innovate. The company adopted MoE architecture, which optimizes available FLOPS by selectively activating only a fraction of the model's parameters during each computation.

Furthermore, DeepSeek's engineers delved into low-level GPU programming using Nvidia's parallel-thread execution (PTX) language. This enabled them to meticulously schedule GPU tasks, overlapping computation with communication to effectively hide latency.[3] Ultimately, they introduced the R1 reasoning model, which capitalized on abundant memory resources to efficiently manage complex, multi-step reasoning processes.

As a result, DeepSeek turned export controls into a strategic advantage. By extracting peak efficiency from constrained hardware, they significantly reduced training and inference costs while achieving performance parity with systems using more powerful GPUs. This case demonstrates how imposed limitations can catalyze breakthrough innovations that reshape competitive dynamics in the AI landscape.

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Impact of efficiency-driven AI on industry development

DeepSeek's cost-efficient models democratize access to advanced AI capabilities, enabling smaller companies, startups and research institutions to participate in AI innovation. This increased accessibility could foster a more diverse AI ecosystem, leading to a broader range of applications and solutions (KPMG, 2025).

Additionally, DeepSeek's success with specialized models may encourage a shift away from the industry's dependence on massive, general-purpose models. This transition could spur the development of efficient, domain-specific AI solutions tailored to industries such as finance, healthcare and manufacturing.

DeepSeek's innovations in training efficiency — such as optimized reward functions and streamlined data selection pipelines — are likely to be adopted industrywide, reducing resource consumption and mitigating the environmental impact of AI development (Bain, 2025).

Lastly, DeepSeek's efficiency-focused approach is expected to drive down the cost of AI inferencing, enabling broader adoption and spurring new AI use cases. As AI-powered services become more affordable, businesses and consumers alike stand to benefit from an expanded range of intelligent applications.

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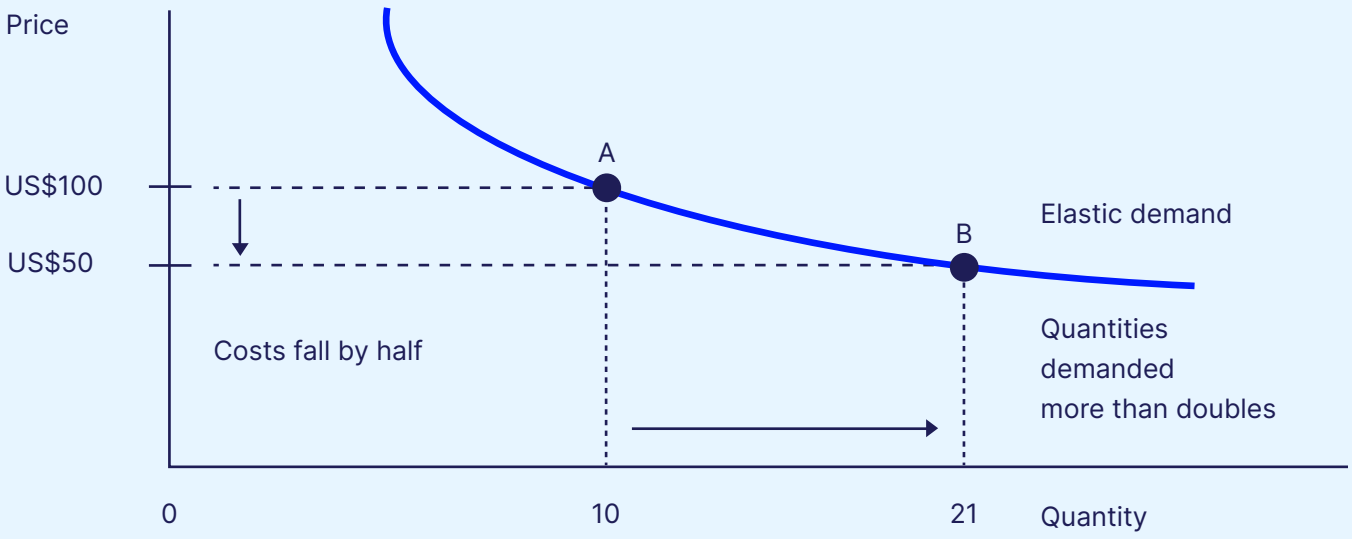
Impact of efficiency-driven AI on hardware demand

DeepSeek's ability to achieve high performance using less powerful GPUs challenges the prevailing assumption that AI progress is inherently tied to increasingly powerful and expensive chips. This could potentially lead to a decrease in demand for the most advanced GPUs, impacting the strategic roadmap of major chip manufacturers.

However, as depicted in Exhibit 2, the Jevons paradox[4] suggests that increased efficiency may lead to greater overall demand for AI chips rather than reduced consumption, as adoption expands and new use cases emerge. As AI becomes more affordable and accessible, adoption may accelerate, driving an overall increase in demand for AI chips — albeit with a potential shift in preference toward more cost-effective alternatives.

Consequently, while demand for top-tier GPUs might decline, the broader need for AI hardware could rise, potentially benefiting companies specializing in application-specific integrated circuits (ASICs) and memory solutions.

Exhibit 2: Jevons paradox



Impact of efficiency-driven AI on cloud computing infrastructure: Opportunities and challenges

DeepSeek's efficiency gains could reshape investment patterns in cloud computing. If AI workloads can be executed effectively on lower-cost hardware, cloud providers may reduce capital expenditures on high-end GPUs, leading to cost savings and potentially lower AI service prices (Bain, 2025).

Moreover, DeepSeek's emphasis on edge computing — processing data closer to the source rather than relying on centralized cloud servers — could accelerate AI adoption in scenarios where real-time processing is critical.

By reducing latency and bandwidth demands, edge AI minimizes reliance on centralized cloud infrastructure, enabling faster and more efficient decision making. This trend is likely to drive the development of new edge AI solutions, fostering a more distributed and resilient AI landscape.[5]

DeepSeek's open-source approach could further reshape the cloud computing ecosystem by validating business models that leverage AI infrastructure while forcing proprietary cloud providers to adapt their strategies.[6]

However, despite these innovations, DeepSeek faces several challenges in gaining widespread adoption. Regulatory scrutiny remains a key obstacle, particularly in Western markets where concerns over data privacy, security and intellectual property rights persist. In response, DeepSeek has already been banned in multiple jurisdictions due to concerns over data security, foreign surveillance risks and compliance with national regulations.

These actions underscore ongoing fears about AI-driven surveillance and data sovereignty. Additionally, integrating DeepSeek's models into existing AI infrastructures requires substantial adaptation efforts from firms that have invested heavily in proprietary architectures.

Nevertheless, DeepSeek's approach represents a fundamental shift in AI development, potentially redefining the economic viability of AI research and deployment on a global scale.

Economic and geopolitical consequences of efficiency-driven AI

DeepSeek's emergence carries profound economic and geopolitical implications. The AI innovation cycle had earlier appeared distinct from previous technology revolutions, due to its reliance on massive capital expenditures, creating a formidable moat between incumbents and challengers. This reinforced the narrative of US exceptionalism in AI.

However, if DeepSeek's approach proves scalable, the AI cycle may begin to resemble past waves of technological innovation, following a familiar pattern:

- Innovation originates in a leading economy (historically the US), attracting massive capital investment.
- This capital fuels high capital expenditure research and business expansion, leading to strong economic growth, currency strength and equity performance.
- Over time, the technology diffuses globally, enabling catch-up growth in other economies and narrowing competitive gaps. Further, as the growth gap narrows, so too does the currency and equity return differential.

The big takeaway from DeepSeek's emergence is that we have advanced faster to the diffusion phase of AI, compressing the timelines in which innovation-driven advantages erode.

Exhibit 3 illustrates how DeepSeek's efficiency-driven AI challenges the traditional high-capital expenditure AI model, accelerating global technology diffusion, intensifying competition and potentially shortening the US AI leadership cycle by reducing barriers to entry. While the democratization of benefits from innovation can happen faster than originally believed, US technological leadership in AI could also be challenged sooner than expected.

Exhibit 3: Paths for the AI innovation cycle

AI emergence

Without efficient-AI

1. Large capex required
- AI demands massive data, compute and infrastructure
- Strong "moat for incumbents"

2. Reinforces US leadership
- US attracts disproportionate investment and talent
- Leads to robust productivity and equity outperformance

3. Gradual diffusion over time
- Technology eventually spreads internationally
- Non-innovators catch up later

4. Erosion of US advantage
- As other economies adopt and adapt the technology
- US "exceptional" status diminishes over a longer horizon

Final outcome
- Traditional cycle of US AI dominance persists longer
- Eventually, global catch-up narrows US advantage

With efficient-AI

DeepSeek moment

1. Reduced capex requirement
- Efficient-AI lowers technical barriers and capital intensity
- Moat for incumbents challenged

2. Accelerates democratization
- Faster global adoption and competition
- Potentially reduces US lead

3. Faster, wider diffusion
- Broader access to AI solutions sooner than expected
- Rising global competition and productivity

4. Earlier erosion of US advantage
- The catch-up phase arrives faster and narrows the growth gap
- US currency and equities could lose relative edge more quickly

Final outcome
- Innovation advantages diffuse faster
- Convergence in growth, currency and equity returns occurs sooner

A central economic question is whether DeepSeek's cost-efficient AI models will stimulate or suppress global AI demand. The Jevons paradox, an economic principle that suggests efficiency improvements often lead to increased overall consumption rather than reduced usage, provides an insightful framework for understanding DeepSeek's market impact. As AI becomes more affordable, its adoption is expected to expand across industries that previously lacked the financial resources to implement it.

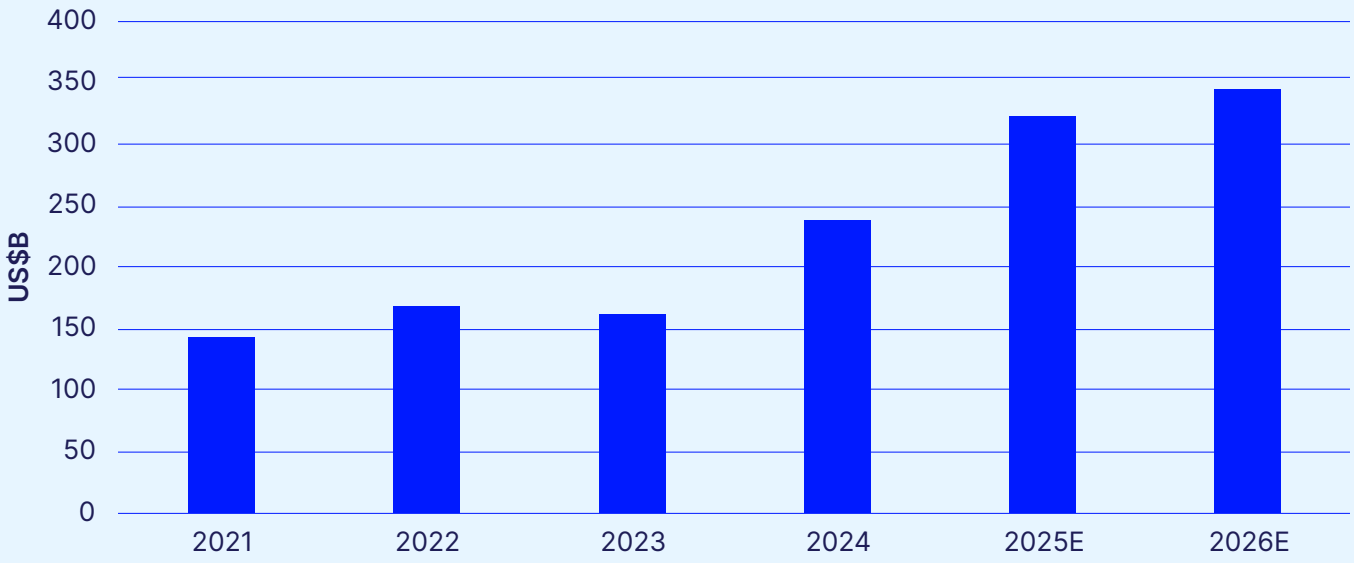
In the long run, DeepSeek's innovation may lower costs for AI-driven firms, particularly in software (Microsoft), cloud computing (Amazon Web Services) and any technology company where inference expenses are a major concern (e.g., Apple and Meta).[7] Microsoft CEO Satya Nadella has explicitly likened DeepSeek's approach to the Jevons paradox, stating that "cheaper AI will lead to a commodity-like proliferation of AI applications, thereby increasing overall demand" (Ferguson, 2025).

From a domestic macroeconomic perspective, the affordability of DeepSeek's AI could significantly disrupt AI investment patterns. At the moment, the scale of AI investment by Big Tech companies is expected to continue to increase, as seen in Exhibit 4. However, companies that previously relied on expensive, proprietary AI solutions may now opt for more cost-effective alternatives, shifting capital away from entrenched AI giants. The resulting redistribution of investment could foster a more competitive and dynamic AI market, reducing the dominance of a few key players.

It could also restart a period of entrepreneurial innovation, as smaller AI startups experiment with new business models — essentially, a return to the era of garage-born tech companies. This shift would attract fresh capital, but in a more distributed fashion. Furthermore, greater accessibility to AI could enhance productivity across multiple industries, raising important questions about its impact on the labor market. While AI-driven automation offers efficiency gains, it also poses challenges related to job displacement and the evolving role of human labor in an AI-centric economy (Bhidé, 2025).

Exhibit 4: Magnificent 7 capital spending

CAPEX of magnificent 7 companies



Source: Bloomberg

On a geopolitical level, DeepSeek's success has reignited debates over global AI leadership and the effectiveness of US export controls. The company's ability to develop high-performing models using older hardware suggests that the current US strategy of restricting China's access to advanced AI chips may have limited efficacy.

If Chinese firms can continue to develop competitive AI models despite these export restrictions, Western policies aimed at curbing China's AI advancements must be reassessed.

Given these dynamics, Western policymakers may need to carefully evaluate their approach to China's AI sector to balance competition, security and innovation while fostering national interests (Zhang, 2025).

Implications for global financial services companies

DeepSeek's breakthrough isn't merely another generative AI (GenAI) model — it represents a fundamentally new cost-efficiency and AI paradigm that could reshape financial services in ways that go beyond current applications.

Its dramatically lower training and operational costs pave the way for a new class of real-time, adaptive decision systems. For example, algorithmic trading platforms that require continuous, self-correcting models could now be deployed at scale without the prohibitive infrastructure costs typically associated with state-of-the-art AI. This shift means that high-performance AI-driven risk management and trading solutions could become accessible not only to major global banks, but also to mid-tier institutions and emerging market players.

DeepSeek's open-source nature further distinguishes its approach. By providing full transparency into its chain-of-thought reasoning process and reinforcement learning protocols, financial institutions could — in principle — customize models for niche applications such as dynamic stress testing, regulatory compliance analytics or real-time anomaly detection in high-frequency trading. In regulated environments where interpretability and auditability are paramount, these advanced reasoning capabilities could be leveraged to create more tailored AI solutions within financial institutions.

Moreover, the efficient use of widely available, less advanced GPUs offers an attractive alternative cost structure that might encourage internal AI research and development within financial firms.

However, despite these advantages, financial services companies in the US — and other jurisdictions with strict data protection and regulatory requirements — are unlikely to directly adopt DeepSeek's technology outright. Its development and deployment on servers located in China involve data processing and storage practices that adhere to Chinese government policies, including content censorship and specific data collection protocols. Such practices could raise significant national security and data privacy concerns among regulators in the US, Europe and other regions. For instance, several US government bodies have already banned DeepSeek's software on official devices due to these issues. As a result, while DeepSeek's methodologies may influence industry practices, financial institutions will likely pursue alternative paths — either developing proprietary adaptations of these techniques or licensing similar AI technologies from vendors that comply with regional and local regulatory requirements.

This raises critical questions about cost competitiveness in AI in the US financial services industry. If US firms remain bound by stricter regulatory frameworks, the resulting compliance and data security costs could make AI adoption more expensive relative to China's more flexible approach.

This structural cost disparity may, over time, give Chinese AI firms a cost advantage in AI-driven applications. However, US firms may mitigate this by accelerating innovation in proprietary AI models, forming strategic partnerships with compliant vendors, or advocating for a more balanced regulatory approach that fosters competitiveness without undermining security and ethical standards.

At the same time, sectors outside the financial services industry, which face fewer data protection mandates, can capitalize on efficiency-driven AI to streamline operations, optimize resource allocation and enhance customer experiences at lower costs.

These sectors can potentially benefit from lower training and operational expenses — reducing capital outlays and energy consumption — compared to the high costs associated with conventional large-scale models.

In summary, while DeepSeek's innovations highlight the potential for cost-efficient, highly adaptive AI solutions in financial services, regulatory and data privacy constraints will prevent direct adoption. Instead, DeepSeek's breakthroughs will likely drive financial firms to emulate its efficiencies through in-house development or strategic partnerships with technology providers that can ensure compliance with regional data security and privacy standards.

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Conclusion

DeepSeek represents a paradigm shift in AI development, combining cost efficiency with cutting-edge advancements in model architecture and training methodologies. Its impact on the AI ecosystem, global economy and financial services sector underscores the transformative potential of efficiency-driven AI. The net effect is not a zero-sum shift away from hardware dependence, but a reconfiguration of AI's technological and economic landscape. However, DeepSeek's emergence also raises critical questions regarding regulatory oversight, geopolitical strategy and the future of AI development.

Policymakers and industry leaders must now determine how to integrate efficiency-driven AI innovations while maintaining robust compliance and security standards.

Future research should explore the long-term economic effects of cost-efficient AI, particularly in areas such as labor markets, investment strategies, AI governance, and energy and infrastructure challenges. As DeepSeek accelerates the democratization of AI capabilities, it ushers in a pivotal moment in AI's evolution — one that requires a careful balance between innovation, security, regulatory alignment and economic development worldwide.

Acknowledgements

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Endnotes

1. There is an ongoing debate about this cost, as DeepSeek's owner has been stockpiling loads of Nvidia chips over recent years, thus enjoying favorable access to prepaid infrastructure.

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4. The Jevons paradox, first articulated by William Stanley Jevons (1865) in the context of coal usage, states that greater efficiency in resource utilization can lead to increases in total resource consumption. Economists explain this with a price-driven demand effect: As the cost of using a resource drops — because it becomes more efficient — new applications and higher demand follow, often offsetting the initial efficiency gains (Polimeni et al., 2009).

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