

Artificial Intelligence, trade, and firm dynamics

Suleyman Gozen, Pinar Gunes, Mehmet Furkan Karaca

Published 17 November 2025

CITP Briefing Paper

Key points

- **AI Adoption Boosts Sales:** Adopting Artificial Intelligence (AI) talent is associated with significantly higher firm sales in the US economy.
- **AI-driven gains are especially large for exporting firms.** Firms with an international presence see an even greater sales uplift from AI adoption than purely domestic firms.
- **The use of AI-skilled workers remains relatively small in scale but uneven across industries and firm types.** High-tech sectors lead with roughly 1% of their workforce having AI-related skills. Larger, older firms and those rich in intangible assets (like R&D and human capital) are far more likely to employ AI workers than smaller or less knowledge-intensive firms.
- **Diminishing Returns for Larger Firms:** The positive effect of AI on sales is strong across the board but tapers for very large firms or those with a high AI workforce share.
- **Smaller versus larger firms reap different benefits from AI.** For smaller firms, AI mainly drives growth in domestic sales, helping them expand in local markets. In contrast, larger firms leverage AI to boost foreign sales, enhancing their export performance.
- **Small firms see persistent increases in home-market revenue, whereas large firms experience lasting gains in international revenue.**

Introduction

Over the past two decades, Artificial Intelligence (AI) has emerged as a transformative technology with significant implications for firm performance. While prior research has largely focused on AI's effects on productivity, innovation, and firm growth¹, its consequences for international trade remain underexplored.

This Briefing Paper contributes to this gap by presenting preliminary findings from research that examines how AI adoption shapes both domestic and export sales across the firm-size distribution. We measure AI adoption through the presence of AI-skilled human capital, reflecting the specialised expertise required for AI-driven processes. Using a novel dataset², we track firms that have adopted AI against those that have not, analysing their performance in domestic and international markets while controlling for firm characteristics such as size and assets. The dataset covers US firms from 2007 to 2018, excluding 2008–2009 due to the global financial crisis.

Our findings indicate that AI adoption has a clear and measurable impact on firm performance. Firms employing AI-skilled workers experience roughly an 18.6% increase in total sales, with the effect particularly pronounced for exporting firms, suggesting that AI confers a competitive advantage in global markets. However, these gains are not uniform: larger firms or those with higher numbers of AI-skilled workers exhibit diminishing returns, highlighting that the relationship between AI adoption and firm performance depends on firm characteristics such as size and market orientation. Accounting for firm-size heterogeneity further clarifies these dynamics: larger firms leverage AI primarily to boost international sales, possibly building on existing resources and market presence, whereas smaller firms benefit more in domestic markets, using AI to strengthen local operations and support growth.

These results extend prior work on AI's productivity effects³ by showing that the benefits of AI manifest differently across domestic and international performance. Our findings provide empirical evidence that the mechanisms proposed in earlier studies—such as productivity gains⁴, improved supply chain efficiency⁵, and reduced trade costs through better logistics and

¹ See Agrawal, A., J. S. Gans, and A. Goldfarb (2019). Artificial intelligence: the ambiguous labor market impact of automating prediction. *Journal of Economic Perspectives* 33(2), 31–50

² The dataset used in this analysis is provided by Babina et al. (2024). Babina, T., A. Fedyk, A. He, and J. Hodson (2024). Artificial intelligence, firm growth, and product innovation. *Journal of Financial Economics* 151, 103745.

³ Ferencz, J., J. L. González, and I. O. García (2022). Artificial intelligence and international trade: Some preliminary implications. *OECD Trade Policy Papers* (260).

⁴ Ibid

⁵ Meltzer, J. P. (2018). The impact of artificial intelligence on international trade. Center for Technology Innovation at Brookings, 9.

coordination⁵—translate into measurable gains at the firm level. Specifically, we confirm that AI adoption affects both domestic and international sales. By foregrounding these effects, our study offers new insights into how AI reshapes firm-level trade dynamics, bridging the gap between the literature on technological adoption and international trade.

By integrating these findings, our study highlights that AI is not only a driver of productivity but also a distinctive driver of trade performance. Smaller and medium-sized firms may benefit most initially in domestic markets, while larger firms can leverage AI to expand internationally—though returns may plateau as AI intensity increases. This nuanced understanding carries important implications for firm investment strategies and for policymakers shaping the future of global trade.

What is AI and why should it matter for trade?

According to the Oxford English Dictionary, Artificial Intelligence (AI) is defined as: “The capacity of computers or other machines to exhibit or simulate intelligent behaviour; the field of study concerned with this. In later use also: software used to perform tasks or produce output previously thought to require human intelligence, especially by using machine learning to extrapolate from large collections of data.”

This definition highlights a key distinction: while traditional technology adoption typically involves implementing tools to automate repetitive tasks or improve efficiency within existing processes, AI adoption introduces adaptive, learning-driven systems capable of handling complex tasks, making predictive decisions, and enabling firms to compete more effectively in global markets. Unlike conventional technologies, AI systems not only automate tasks but also continuously evolve and optimise based on new data, allowing firms to boost productivity, streamline supply chains, and lower trade costs. Accordingly, we distinguish AI adoption from traditional technology adoption, particularly in the context of international trade.

This distinction is especially important for trade. While conventional technologies may primarily enhance domestic operations, AI's ability to improve export competitiveness and optimise cross-border supply chains creates new opportunities for firms to expand their global reach. This is why we focus on the unique role of AI as a distinct and powerful driver of change, extending beyond the capabilities of earlier technological innovations. It must be acknowledged, however, that these mechanisms remain hypothetical, and our empirical results do not permit definitive identification of the underlying channels. One plausible explanation is that AI's data-analytic and predictive capabilities—such as real-time demand forecasting, logistics optimisation, and automated decision-making—may be especially valuable in managing the uncertainty and informational asymmetries characteristic of global markets.

Further research is therefore required to substantiate these hypotheses and to delineate more precisely the ways in which AI may differentially affect export-oriented versus domestically focused activities. As AI technology continues to evolve and still faces limitations, it has the potential to benefit international trade in three main ways.⁷ First, AI adoption can boost firms' productivity, enabling larger gains from trade through exports. For example, manufacturing firms using AI-driven predictive maintenance tools can reduce machinery downtime and cut operational costs, making their products more competitive internationally. Second, AI can enhance supply chain efficiency.⁸ This includes smarter and more automated manufacturing processes, improved demand forecasting, and better decision-making regarding production locations. For instance, some firms use AI to optimise delivery routes, lowering fuel costs and shortening delivery times, while global retailers use AI to forecast consumer demand more accurately, allowing for just-in-time inventory systems that reduce waste and better align production with market needs. Third, AI can help reduce trade costs — not only by improving logistical efficiency and bridging communication barriers but also by enhancing the ability to connect supply with demand across borders. In addition, the use of AI in customs and border agencies for trade facilitation can further lower trade costs by streamlining procedures at the border.⁹

Firm-level AI adoption trends

Although AI plays an increasingly important role in international trade, its adoption varies significantly across industries. Using data from researchers Babina et al.¹⁰, we measure a firm's AI adoption by the share of AI-skilled employees, reflecting AI's reliance on human expertise. This approach is particularly suitable in our context because AI adoption depends heavily on specialised human capital. Unlike traditional technologies, the primary input for implementing AI systems is skilled labour—such as data scientists, machine learning engineers, and related specialists—whose presence directly indicates a firm's capacity to develop and deploy AI.

It is important to note that the concept of AI in this paper does not refer to simple, user-friendly tools (e.g., ChatGPT) that require no formal training. Instead, AI skills in our context refer to advanced competencies—such as Kernel Methods or XGboost—that are closely related to core AI domains including machine learning, computer vision, and natural language processing (see Babina et al. for a full list of AI skills). Therefore, measuring the share of AI-skilled employees offers a meaningful and scalable indicator of firms' AI engagement across sectors for the purposes of our study.

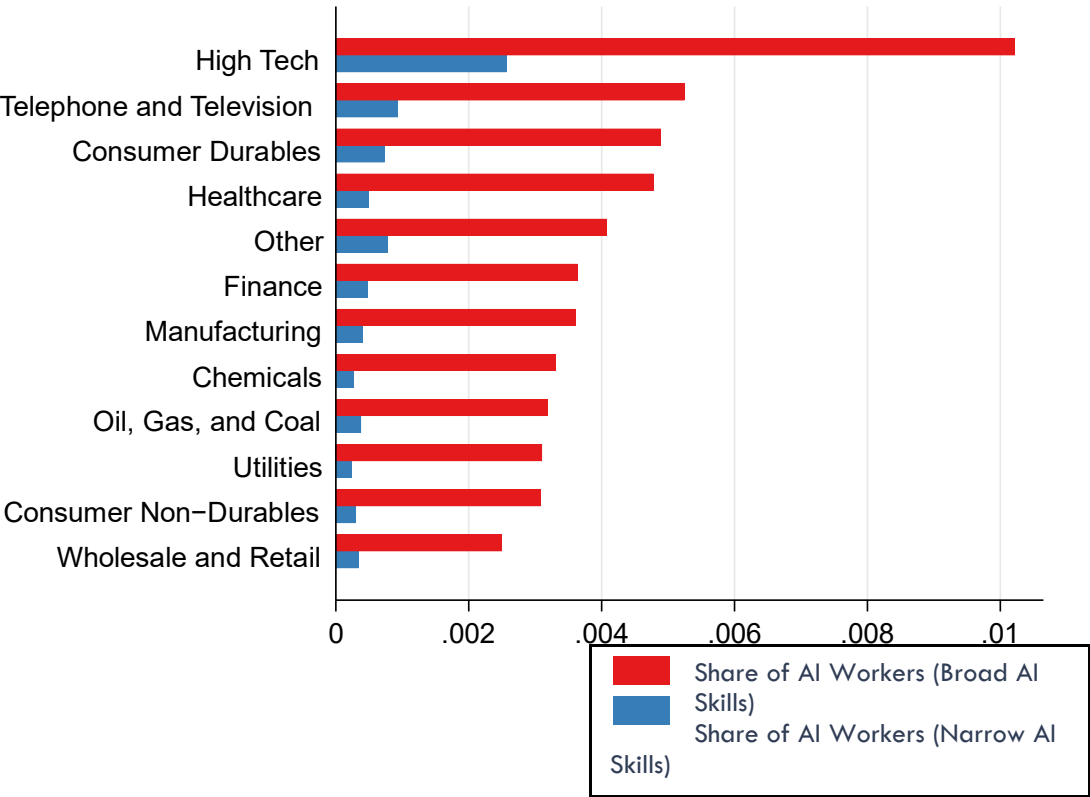
⁶ Brynjolfsson, E., X. Hui, and M. Liu (2019). Does machine translation affect international trade? evidence from a large digital platform. *Management Science* 65(12), 5449–5460.; Lo, C. P. and Y. Lee (2024). Digitalization, ai intensity, and international trade. *Annals of Economics and Finance* 25(1), 251–273.; Xu, X. and C. Tian (2023). Does artificial intelligence improve the quality of export products? Evidence from China. *Applied Economics Letters*, 1–5.

⁷ Ferencz, J., J. L. González, and I. O. García (2022). *Artificial intelligence and international trade: Some preliminary implications*. OECD Trade Policy Papers (260).

Consistent with the literature, we classify AI skills into broad and narrow categories. Broad AI skills are capable of performing a broad range of tasks by using human-like cognitive capabilities, whereas narrow AI skills refer to skills that focus on a specific goal and incapable of solving unfamiliar situations. In our analysis, we focus primarily on broad AI skills unless stated otherwise. The high-tech industry has by far the highest share of the AI workforce, with about 1% of the workers on average possessing AI-related skills (see Figure 1). Other innovation-intensive industries like healthcare, manufacturing, and consumer durables also show above-average AI adoption, especially when measuring broad AI skills. In contrast, more traditional industries (e.g. wholesale and retail) lag dramatically, with near-zero AI worker presence on average. This highlights substantial variety in how different sectors are integrating AI into their workforce.

⁸ Meltzer, J. P. (2018). The impact of artificial intelligence on international trade. Center for Technology Innovation at Brookings, 9.
⁹ Ferencz, J., J. L. González, and I. O. García (2022). Artificial intelligence and international trade: Some preliminary implications. OECD Trade Policy Papers (260).
¹⁰ Babina, T., A. Fedyk, A. He, and J. Hodson (2024). Artificial intelligence, firm growth, and product innovation. Journal of Financial Economics 151, 103745.

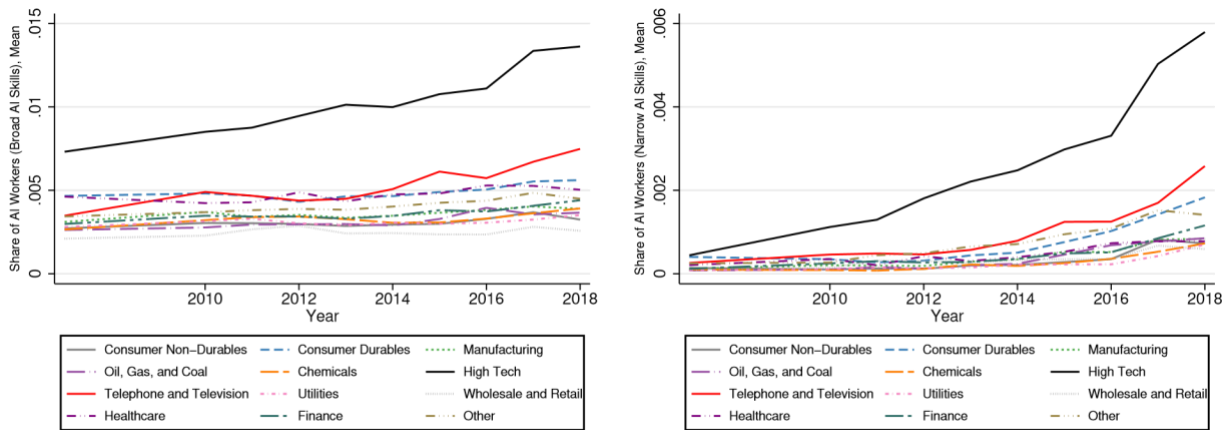
Figure 1: Share of AI workers by industry, mean



Note: This figure presents the share of AI workers across the Fama-French 12 industries, using two measures based on broad AI skills and narrow AI skills.

As shown in Figure 2, over the last decade, the gap has only widened: tech-oriented industries have rapidly increased their AI workforce, whereas adoption in more traditional sectors remains negligible. Growth trajectories diverge – for instance, high-tech and telecommunications show steep increases in the share of AI workers since 2010, while most others exhibit flat or modest growth. Especially for specialised “narrow” AI skills, the divide between cutting-edge industries and the rest has grown more pronounced in recent years.

Figure 2: Share of AI Workers by industry, over time



(a) Share of AI Workers (Broad AI Skills)

(b) Share of AI Workers (Narrow AI Skills)

Note: This figure shows the evolution of the share of AI workers over time across the Fama-French 12 industries, using two measures based on broad AI skills and narrow AI skills.

We also find that within any given industry, larger firms are significantly more likely to employ AI-skilled workers than smaller ones. Companies in the top quintile of AI workforce share tend to be much bigger, with substantially higher assets and sales than those in the bottom quintile. Firms in the highest quintile in terms of AI workers typically generate higher sales and possess larger asset bases, suggesting that scale and financial resources are key enablers of AI adoption. In contrast, smaller firms rarely employ AI-skilled workers.

Impact on firm sales

Analysing the impact of hiring AI-skilled employees on firm sales is not straightforward. A major challenge for this causal relationship is potential selection bias: firms' decisions on AI workforce hiring may be influenced by factors that also affect sales outcomes, and the AI-adopting firms and non-AI adopting firms may be inherently different, which can bias our results. To address this issue, we use, “propensity score matching”. The idea behind propensity score matching is to compare the changes in an outcome variable (such as sales) across firms that are as similar as possible, and where the difference between them is whether they are ‘AI-adopting’. This means that we match firms based on observable characteristics—firm size, age, markup, and Tobin's Q¹¹—within each Fama-French 12 industry¹² and year¹³.

This creates comparable treatment, and control groups and helps isolate the effect of AI workers. Using this approach, we estimate how having AI-skilled employees affects firm-level domestic and foreign sales across the firm-size distribution.

Our findings suggest that employing AI workers translates into significantly higher sales at the firm level. Companies that hire employees with AI skills tend to see a clear and lasting increase in their sales performance. Our findings suggest a strong and consistent link between bringing AI talent into the workforce and higher sales at the firm level.

When we compare similar companies — those operating in the same industry, of similar size, and with comparable characteristics — the difference is striking. On average, firms with AI-skilled employees generate 18.6% more in total sales than those without. This suggests that hiring AI talent is not just something larger or more tech-oriented firms do — it is a factor that directly contributes to higher sales for all types of firms. In practical terms, this means that two companies competing in the same market can have very different outcomes depending on whether they invest in AI talent. Those that do are more likely to outperform their peers in sales, highlighting the growing importance of AI skills as a competitive advantage.

Moreover, these gains are not short-lived. Companies that adopt AI talent continue to benefit for five years, with no signs that the effect fades over time. This lasting impact reinforces the idea that building AI capabilities within the workforce is not just a temporary edge — it is a long-term investment in stronger performance and future growth.

¹¹Tobin's Q is a ratio that compares a company's market value to the cost of replacing its assets. In simple terms, it measures how much investors think a firm is worth relative to what it would cost to rebuild the same company from scratch. A Tobin's Q greater than one means the market values the company more highly than the cost of its assets, suggesting that investors expect strong future growth, innovation, or profitability. Conversely, a Tobin's Q below one implies that the market views the company as less efficient or less promising than the value of its existing assets would suggest.

¹² The Fama–French 12 industry classification is a way of grouping companies into 12 broad industry categories including Consumer non-durables, Consumer durables, Manufacturing, Energy, Chemicals, High-technology, Telecommunications, Utilities, Health care, Finance, Wholesale and retail and Other.

¹³ Koch, M., I. Manuylov, and M. Smolka (2021). Robots and firms. *The Economic Journal* 131(638), 2553–2584.

Impact of AI on international sales

The positive sales impact of AI manifests itself in both domestic and international markets, but its effect differs by firm type. For firms engaged in exporting, AI-adoption appears to particularly boost their foreign sales. The findings show that the sales increase related to AI-adoption is 25% larger if the firm operates in international markets. This suggests that AI helps firms scale up exports – likely through improved efficiency, product quality, or capacity that enhances global competitiveness. In fact, the data implies that an exporter that employs AI enjoys an additional 26% increase in revenue over an equivalent exporter without AI, on top of the overall 18% increase. On the other hand, firms focused on the domestic market also benefit from AI via higher domestic sales, though the relative gains are not as large as the gains for exporting firms.

The size of a firm matters

When it comes to how much AI boosts sales across firm size, not all companies are the same: the impact of AI on sales, though positive in every group, declines for larger companies. In other words, a small or mid-sized firm adding its first AI-trained employees might see a large jump in sales, whereas a giant firm that already employs many AI experts experiences a more modest incremental gain. This result is interpreted as evidence of diminishing returns to AI at scale. Once a firm is very large or has saturated its processes with AI, each additional AI worker contributes less to further sales growth. There may be organisational limits or decreasing marginal productivity of AI when a firm is already at the technological frontier. Conversely, smaller firms operating below their potential can realise efficiency gains quickly by adopting AI, significantly improving output or lowering costs initially.

Firm size also interacts with where the sales gains from AI materialise (domestic versus foreign markets). We find a varied pattern in which market firms benefit most. Smaller firms predominantly see their AI-related sales increases in domestic markets, indicating that AI helps them compete and grow at home first. These firms often lack a global footprint, so AI may enable them to scale up locally – improving efficiency, production, or marketing in the domestic arena, which translates into higher local sales. On the other hand, larger firms – many of which are exporters – experience disproportionate gains in foreign sales from AI adoption. For big firms, AI likely enhances their ability to design, produce, and deliver products for export, amplifying their success abroad. After adopting AI, small firms show a persistent rise in domestic sales paths, whereas large firms show a persistent rise in foreign sales. Essentially, AI helps level the playing field differently: it enables smaller companies to solidify their domestic base, and it helps large companies extend their international reach. This difference is crucial for understanding the nuanced role of AI in firm dynamics – policymakers should account for the fact that AI can fuel growth, but the locus of that growth (home versus foreign) depends on the firm's scale and market scope.

Policy implications

Our findings highlight important directions for policymakers looking to support technology adoption, business growth, and global competitiveness. A key takeaway is the need for targeted efforts to help smaller firms embrace AI. Since our work shows these businesses achieve significant growth in domestic sales and operational efficiency through AI, policies could focus on removing barriers to their adoption. This might involve funding training programs for employees or expanding access to high-speed internet and tech tools—enabling small companies to use AI more effectively. By doing so, governments can empower these businesses to grow and thrive locally first, which fosters broader economic development. Such support would help level the playing field: giving smaller companies tools to compete with larger, tech-forward firms, not just domestically but eventually in global markets too. It also ensures that productivity gains from AI spread across the economy instead of concentrating only in a few large corporations.

Meanwhile, larger exporting firms require different support to maintain their global edge. The research reveals that big companies already use AI to drive major gains in international sales, so governments should encourage continuous innovation here. This could mean creating partnerships between businesses and research institutions to advance AI applications or designing regulations that simplify the use of AI in logistics and production. Trade policies can also play a role—for example, establishing global standards for digital trade or easing cross-border barriers for AI-powered services—thereby amplifying the economic benefits of AI adoption.

Importantly, diminishing returns at extremely high levels of AI adoption signal a need for nuance in policy. Simply pushing large firms to adopt even more AI will not guarantee proportional growth. Instead, policymakers should aim for balanced adoption across all firm sizes. This means investing in training, infrastructure, and incentives so that small and medium-sized

businesses can harness AI as effectively as possible. Doing this ensures resources are used efficiently, boosting domestic resilience and international trade performance while reducing gaps between early adopters and others.

The bottom line is clear: AI can supercharge economic growth, but its benefits depend on how well policies match the needs of businesses at every scale.

Conclusion

In summary, our analysis highlights the significant impact of AI adoption on firm performance, particularly in increasing sales, with stronger effects observed for exporting firms. Although AI improves efficiency and competitiveness across industries, its benefits vary by firm size: Smaller firms primarily experience domestic growth, while larger firms leverage AI to expand internationally. However, diminishing returns suggest that simply increasing AI adoption beyond a certain point may not yield proportional gains. These findings highlight the need for targeted policies that support the diffusion of AI among smaller firms while fostering continued innovation for large companies. By ensuring broad-based and strategic adoption of AI, policymakers can maximise its economic benefits, enhance trade competitiveness, and drive sustainable growth.

However, it is important to note that our work predates the current AI boom due to data limitations, which may have amplified the patterns observed. The findings presented here provide a baseline for understanding AI adoption's impact on firm performance, but the recent surge in AI technologies could strengthen or modify these effects in today's context.