AI productivity gains may be smaller than you're expecting

Much is made of Artificial Intelligence's potential to transform labour markets and make productivity gains. But at a macro level, we think those AI productivity gains, while significant, may not be quite so spectacular

Source: AI generated image

Artificial Intelligence is discussed not only as a potential source of radically transforming labour markets but also as something that could bring about major productivity gains. And not just for specific companies or sectors but for the economy as a whole. According to some, the technology is so revolutionary that it could lead to a positive productivity shock, capable of creating stronger

economic growth. So, is this just a sci-fi movie plotline, or could it be an economic reality? Just what sort of productivity gains can we expect from AI at the macroeconomic level?

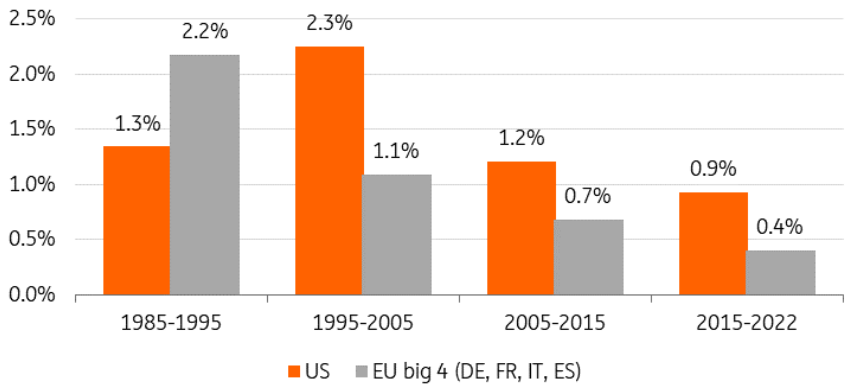
AI's impact has yet to show in country-level data

Despite the increasing adoption of AI and other technological advancements over the last decade, productivity growth in many developed economies has been relatively slow in recent years. The current absence of a big AI impact on country-level productivity figures does not mean, however, that there will be no impact at all. In fact, it is simply too early for the impact to already be felt in aggregate figures.

The delayed impact of technological innovations on productivity is not unique to AI. Electricity was introduced at the end of the 19th century, but its impact on productivity only materialised after the First World War. The same is true with the developments of the internet and personal computers in the early 80s, when Solow made his famous quip about computers and productivity, namely that "*the computer age is visible everywhere, except in productivity statistics*". Indeed, it seems that we are once again faced with Solow's paradox (1987).

Average annual growth of labour productivity

Real GDP per hour worked



Source: OECD, ING Calculations

A latent productivity effect

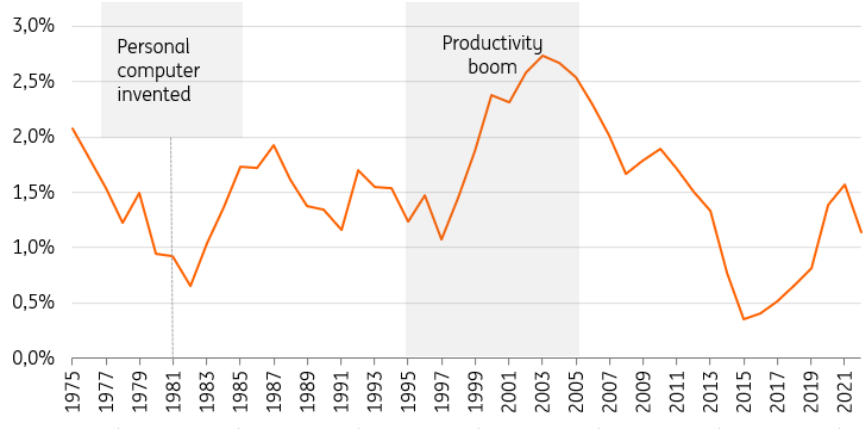
In 1987, many believed the computer had merely yielded a transformation of work but had not increased productivity; the productivity effect would follow much later. From 1995 to 2005, productivity grew at a much higher rate in the US than in previous years (2.3% per year on average between 1995 and 2005 versus 1.3% during the decade before). Both in the case of the invention of electricity and of the computer, a profound productivity boom started in the US about 20 years after the emergence of the new technology, at a point when roughly half of businesses had adopted the technology.

There was no such boom in Europe

It is interesting to note that there was no such boom in Europe, where productivity actually fell after 1995. Research shows that the decline in labour productivity growth resulted from both lower capital deepening - associated with the robust pace of job creation, and lower total factor productivity growth - which the higher utilisation of lower-skilled workers might partly explain. Moreover, the euro area economy seems to have benefited much less from increased production and use of ICT technologies, particularly in the services sector (Gomez-Salvador et al., 2006).

Annual real labour productivity growth

Growth of real GDP per hour worked in the US, %YoY, 5Y moving average



Source: OECD, ING Calculations

Economic literature has shown that the invention of general-purpose technologies such as electricity and the personal computer initially led to a fall in productivity, as it forced changes in production methods, company organisation and investment in human capital. As a result, productivity growth tends to follow a J-curve during such technological progress: productivity growth first declines during the first phases of the diffusion of the new technology before increasing in a second phase (Brynjolfsson et al., 2020).

A macro impact should be felt, but not immediately

It could be argued that the situation is different this time and that AI's impact on productivity may take less time to be felt. Indeed, the effect of the Internet on productivity took time to be felt because it required major investment in infrastructure (computers, internet, etc.). However, due to the already existing infrastructure, it is easier for the end-user to access the newest models, making distribution faster.

ChatGPT famously was the most rapid product launch in history

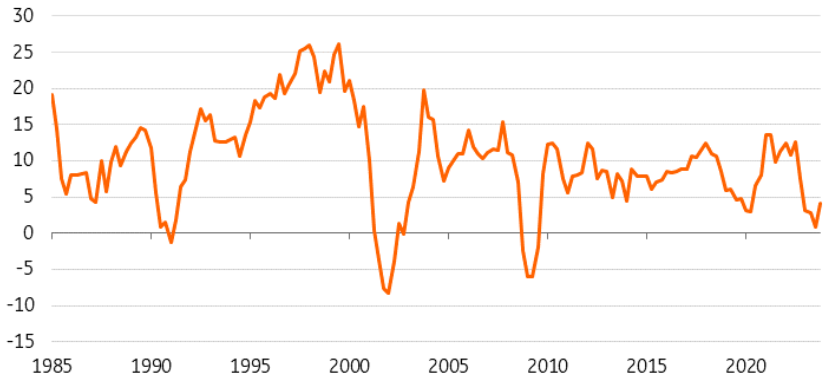
ChatGPT famously was the most rapid product launch in history—it gained 100 million users in just two months—because it was accessible to anyone with an internet connection and did not require any hardware investment on the users' side. In addition, interaction with natural language can make learning easier, requiring a shorter period of investment in new human capital. Nevertheless,

some research suggests that the time profile of AI's impact on productivity does indeed follow a J-shaped curve, with effects being small or even decreasing at the start of AI diffusion, then increasing and becoming positive in a second phase (Venturini, 2019). It's also not only about the end user but because generative AI requires investments in ultrafast chips, microprocessors, and data centres.

It is also interesting to note that, in the United States, the productivity boom of the late 1990s was preceded by a 2-to-3-year surge in private investment in information processing equipment and software. It is reasonable to assume that similar developments will happen now. In fact, an investment boom in tech looks like a prerequisite for any productivity surge at the macroeconomic level linked to AI. However, there is little evidence of that at the moment. In the United States, real private investment in information processing equipment and software has not been particularly forthcoming in recent years.

Real growth of private fixed investment in information processing equipment & software

Yearly real growth in percentage terms, United States



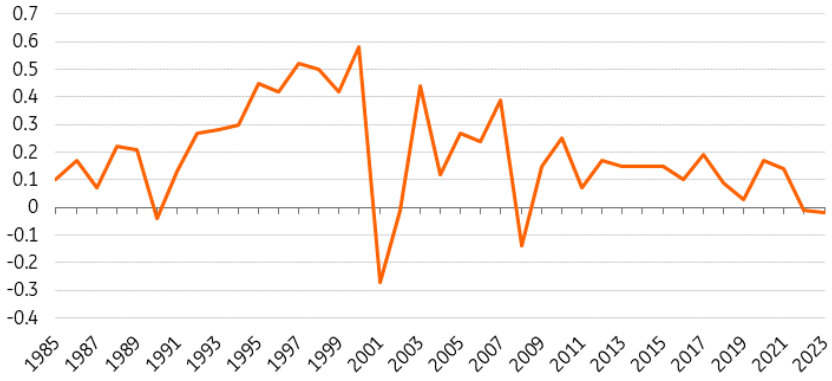
Source: LSEG Datastream, ING Calculations

Also in the US, investment in information processing equipment has contributed little to real GDP growth in the past few years. However, we did see a rebound in the fourth quarter of 2023.

It's clear that some technology companies are making significant investments, but this has yet to make a difference at a macro level. Against this backdrop, it is hard to believe that productivity will rise sharply at the macroeconomic level over the next two years. We believe the time needed to feel the effects of AI on productivity data at country-level will probably be shorter this time than during the Internet revolution, but it won't be immediate either. We'll have to wait some years to really start seeing the productivity boom in macro data.

Contribution of private investment in information processing equipment to growth

Contribution of private investment in information processing equipment to real quarterly GDP growth in the US (average over the year)



Source: LSEG Datastream, BEA, ING Calculations

Productivity 'leakage'

While country-level statistics do not reveal significant productivity growth for now, company-level analyses tell a different story. For instance,

- Kanazawa et al. (2022) estimated and compared taxi drivers' cruising time, i.e. the time needed to find a new customer, using AI and without using it. They discovered that driver productivity improved only for low-skilled drivers, reducing the productivity gap between high-skilled and low-skilled drivers by 14%.
- Brynjolfsson et al. (2023) studied the productivity of customer care agents using a conversational assistant based on generative AI. They found a 14% increase in worker productivity, significantly impacting new and low-skilled workers and little effect on experienced and high-skilled workers.
- Dell'Acqua et al. (2023) conducted an experiment on 18 realistic consulting tasks with or without AI and showed that, with AI, tasks were performed 25% more quickly, quality increased by more than 40% and task completion by 12%.
- Kalliamvakou (2022) finds that software engineers can code up to twice as fast using a tool called Codex, based on the previous version of the large language model GPT-3.
- Noy and Zhang (2023) find that many writing tasks can also be completed twice as fast
- Korinek (2023) estimates, based on 25 use cases for language models, that economists can be 10-20% more productive using large language models.

Firm-level academic studies generally find that AI adoption increases within-firm annual worker productivity growth by 2-3 percentage points. Based on these studies, most, such as IMF and Briggs and Kodnani for Goldman Sachs, assume that productivity increase at the country level would be at least equivalent to a 1.5 percentage point increase in the workers' average annual productivity growth rate over a 10-year period after the start of the productivity boom. This would be a gigantic positive shock. Over the past five years, on average, real labour productivity growth was 1.1% in the US and 0.8% in the EU. A 1.5pp increase would mean a tripling of productivity in the EU and a doubling in the US.

Productivity gains of AI are likely to be much smaller in some sectors

We are less upbeat and believe that the productivity gains generated by AI at the macro level will be significant, but the incremental effect will be smaller than that. It seems doubtful to us to generalise the results of studies carried out on the first companies that adopted AI for the economy as a whole. While specific departments in certain companies will benefit from significant productivity gains once AI is widely used, this will not be the case for all departments or companies. It is unlikely that all sectors will be impacted as favourably as the companies where the impact of AI has been studied.

More unfavourable preconditions (more investment to be made before implementing AI, workers who need to be trained more because they have less prior knowledge, more difficulties in gathering the data required to train the AI, etc.) mean that the productivity gains of AI are likely to be much smaller in some sectors and some companies, reducing the impact on productivity statistics at the macroeconomic level. Also, not all workers will be impacted by AI, as shown in our recent study on AI's impact on the labour market. While some 60% of the activities of the workforce in the US and eurozone might be exposed to AI, 40% might not feel any impact at all.

Furthermore, generalising the results of microeconomic studies to the macroeconomic level has the disadvantage of not considering the 'leakage' of productivity linked to the increasingly intensive use of this technology. For example, cybersecurity risks, political disruptions and energy shortages are likely to limit total productivity gains (the International Energy Agency estimates power demand from data centres globally could top 1,000 TWh by 2026 — double 2022 levels and an increase equivalent to Germany's total power demand).

We estimate that the productivity gains linked to AI alone could ultimately be close to 1 percentage point, an impact equivalent to that of the invention of the personal computer and the internet. However, this does not mean that productivity growth will actually increase by 1pp. At a time when AI could be driving productivity gains, other factors, including the ageing of the population and the declining productivity gains of earlier innovations, will be working in the other direction and weighing on productivity growth.

Negative factors can offset positive AI productivity contributions

With negative factors offsetting the positive contributions expected by AI, productivity growth might not fall as much as we imagined before the development of AI, but we could see some small positive trends instead. All things considered, we expect annual productivity growth to rise over the next few years, but this will be in the region of 0.1 to 0.5 percentage points.

Achieving macro-level productivity gains equivalent to a 1.5 pp increase in the average annual productivity of workers, AI would need to not only speed up tasks and processes but also significantly accelerate research and invention in other domains. If AI were indeed to make this

possible, the biggest impact on productivity growth would be seen in 10 to 15 years.

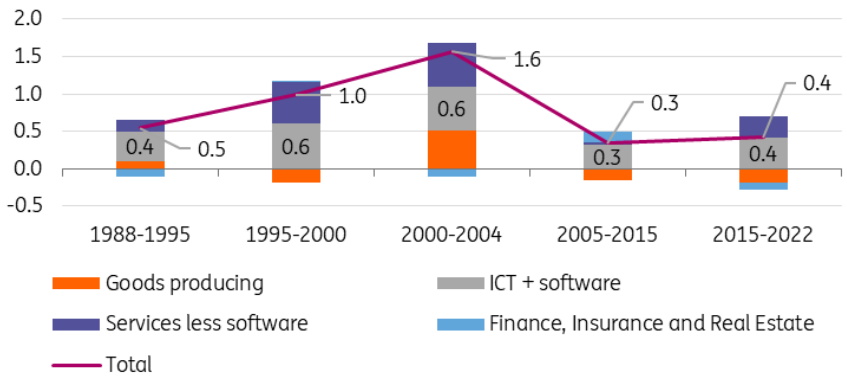
The United States is set to outperform Europe

Furthermore, productivity gains are likely to vary from region to region. Looking once again at the productivity shock of the 1990s that followed the invention of the personal computer leads to some interesting conclusions about who is most likely to gain from the AI revolution.

When we examine the contribution of the ICT (Information Communication & Technology) sector to total factor productivity (TFP) over different periods in the US, it becomes clear that the ICT sector has been the driving force behind the increase in TFP over the last few decades. Furthermore, analysis of the previous productivity shock shows a two-stage story. Firstly, between 1995 and 2000, more than 60% of the productivity gains were due to the ICT sector (i.e. productivity gains realised within this sector), even though this sector represented only 5% of the US economy. Then, between 2000 and 2004, productivity gains spread to the economy as a whole so that productivity gains within the ICT sector only accounted for a third of total productivity gains.

Productivity contributions to output growth by sectors

Total factor productivity contributions to output growth by sectors in private business in the US



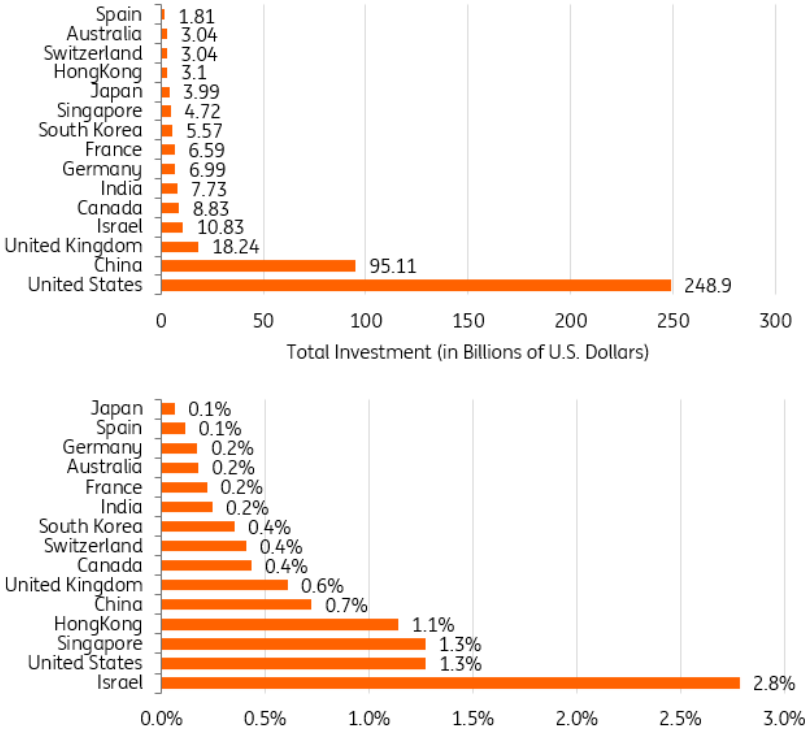
Source: US Bureau of Labour Statistics, ING calculations

The same kind of process could take place with AI. Initially, total productivity gains in the economy are likely to be driven to a considerable extent by the technology producers in a broad sense. This implies that the size of the ICT-producing sector matters. Countries with a larger ICT sector will enjoy faster productivity gains.

The United States, where the ICT sector represents 9.3% of GDP, is therefore likely to benefit from faster and greater productivity gains than the European Union, where the ICT sector represents only 5% of GDP. In addition to the current size of the ICT sector, it should be noted that the US invested much more in AI than European countries, also with government support being extremely high. These two factors alone lead us to believe that the productivity shock will be much bigger and faster in the United States than in Europe.

Private investment in AI between 2013 and 2022 by geography

Sum of private investment in AI between 2013 and 2022 by geographic area, in billions of US dollars and as a percentage of 2022 real GDP (%)



Source: HAI AI Index Report 2023, LSEG Datastream, ING Calculations

In a second phase, productivity gains at macroeconomic level will be generated more using the technology. Countries that do not produce AI technology but only use it could, in turn, see their macro-level labour productivity increase. Nevertheless, as during the productivity shock of the end of the 90s, the fact of producing the technology will continue to play a role. Ultimately, the countries that produce AI could see sustainably higher productivity gains than those that do not make the technology but only use it. We, therefore, expect the US to experience a faster productivity boom than the EU. The EU is also likely to see a rise in productivity, but this will take longer, and the rise is likely to remain persistently lower than that seen in the US.

The market for risk capital is less developed in Europe

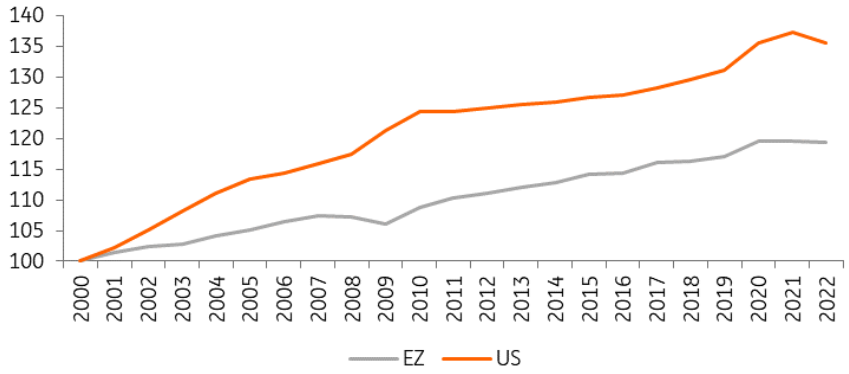
Several other factors are likely to limit the impact of AI on European productivity compared with other developed economies. In particular, the market for risk capital is less developed and not unified in Europe. There are also many languages used in Europe, making AI models more complex to learn. Data protection regulations are stricter here, too, meaning there is less data available to train AI models. And future regulatory pressures will also be stricter in Europe than in the US, with the EU having passed the first AI law in the world in March, and that will come into effect in 2026.

It should also be mentioned that the US appears to be particularly keen to remain at the forefront of this topic. A desire to reshore activity, to secure supply chains and to ensure an ongoing technological edge over China is high and will likely leave Europe trailing.

Weaker productivity gains in the eurozone than in the US mean that the potential growth gap will likely widen over the next few years.

Labor productivity level in the USA and the eurozone

Real GDP per hour worked, 2000 = 100



Source: OECD data, ING calculations

To conclude, we believe that AI will indeed lead to a positive productivity shock at the macroeconomic level. However, the gains will be more limited and gradual than some people expect. Also, considering the other factors that are weighing on productivity growth, annual worker productivity could increase by 0.1 to 0.5 percentage points over the next few years. The USA is likely to benefit more than Europe, reinforcing the gap in worker productivity between the two sides of the Atlantic.

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