Some observers are predicting a very big uplift to global productivity and economic growth from developments in artificial intelligence. But our historical analysis of productivity growth and technological change suggests that while AI could be transformative for some sectors, it’s unlikely to shift world growth on to a markedly higher path.

Global growth has been trending down since the early 2000s, partly due to slower productivity growth. Demographics will be a drag in the decades ahead. To return growth in advanced economies to a 1990s-2000s pace would require total factor productivity growth to quadruple – a huge ask.

Periods of much faster productivity growth are visible since the 19th century. Some of these periods were long lasting and were closely linked to the rise of new technologies such as railways, electric power, and computers. AI, as a general-purpose technology with potentially large spillovers, could in principle produce similar results.

However, not all new technologies have lived up to their initial promise, and even when they have the impact on aggregate growth has sometimes been modest. Often, the gains came many years after the technology was first invented, due to lags such as slow diffusion into the capital stock. The benefits of electrification, for example, took decades to appear in the US data.

What’s more, new tech has sometimes boosted productivity levels but not had permanent positive effects on productivity growth. US productivity growth got a strong fillip from computer technology advances in the mid-1990s to the early 2000s, but this happened a long time after computers were invented, didn’t last, and wasn’t replicated for the European economies.

Emerging evidence suggests that AI will lead to strong productivity growth in at least some sectors. But in the absence of widespread adoption and large-scale innovation resulting from using AI, the economic gains could be narrow for a long time.

Chart 1: World growth set to slow in the decades ahead

Advanced economies: Potential growth
Percentage point contributions to potential growth

<table>
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<th>1993-02</th>
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Source: Oxford Economics
AI and productivity growth – a note of caution

AI and the global growth challenge

Recent advances in artificial intelligence have prompted some observers to predict a dramatic improvement in productivity growth, sufficient even to reverse the depressing trend of lower global growth visible since the early 2000s. One estimate suggests labour productivity growth might rise by 1.5 percentage points per year and that world GDP could rise by 7% over a decade.

Such a huge uplift to productivity and growth would certainly be very welcome, but how realistic is it?

Firstly, the world economy faces a number of headwinds to growth in the years ahead. One of these is demographics – the contribution of labour supply to growth in the advanced economies has been waning and will drop to zero in the 2030s (Chart 1). For some emerging economies, including China, the picture will be even worse.

Secondly, productivity growth in the years ahead may also be damaged by the recent huge economic shocks. The oil shock in 1973 and the global financial crisis of 2008-2010 contributed to notable slowdowns in the growth of total factor productivity (TFP, the efficiency of use of all inputs into production). Likewise, the lingering impacts of the pandemic and the Russia-Ukraine war could also depress productivity growth (Chart 2).

Chart 2: Downside risks to productivity from economic shocks

G7: Total factor productivity growth

Source: Oxford Economics/Feenstra et al./Penn World Tables

AI would need to have a massive impact on productivity to reverse this negative trend. Even getting advanced economy potential growth in 2033-2042 back to the 2003-2012 level of 1.8% per year would, all else equal, require TFP growth to double compared to our baseline forecast. To get growth back to the levels of 1993-2002 would require TFP growth to quadruple – a massive task.

Past surges in productivity growth – what can we learn?

The historical record does give some cause for optimism, inasmuch as we can identify several periods of accelerated growth in productivity in advanced economies since the 19th century some of which lasted for extended periods. These include the UK in the mid-19th century, the US from 1891-1913, Europe in the 1950s-early 1960s, the UK in the 1980s, and the US from 1999-2010. In four out of five of these cases, GDP per head levels rose 10%-20% versus the level that would have prevailed had productivity growth continued at the previous pace. The post-war European experience stands out with a rise of 50% (Chart 3).
However, a careful examination of these historical episodes suggests several reasons to be cautious about the productivity-boosting potential of AI:

- In some cases, such as post-war Europe, the productivity gains resulted from unique historical circumstances;
- The positive impact of new technologies on productivity was sometimes modest and some new technologies failed to deliver any boost at all;
- There was often a lengthy gap between the invention of new technologies and any significant impact on growth – sometimes decades;
- In some cases, productivity gains from new technologies were very uneven across economies; and
- The boost to productivity was sometimes not permanent, wearing off after a relatively short period. These periods saw an uplift to the level of productivity but not a permanent effect on the growth rate of productivity.

**Post-war Europe.** The post-war European experience is probably not a good example of the kind of tech-driven growth boost some observers are hoping for from AI. It had a variety of causes including structural change, US aid (the Marshall Plan), growing intra-European trade, and reconstruction growth. Of these, the last was probably most important. German GDP in 1948 was a third lower than in 1938 and the very rapid growth of 1948-1960 only took German GDP per capita back to where it might have been, based on interwar trends, had the war not intervened.

**The UK in the 19th century.** A more interesting example is UK productivity growth in the mid-18th to early 19th century. Looking at this period, it’s striking that there is no pick-up visible in productivity growth, which ran at only around 0.4% per year. This is despite it being the dawn of the industrial revolution, featuring a host of important inventions including the steam engine and new techniques in textile and iron manufacturing (**Chart 4**). It seems that the benefits of these inventions were very slow to diffuse through the economy, with sectors outside the key industries using these inventions only experiencing very slow productivity growth. **Crafts** reports estimates that the steam engine (invented in 1769) only added 0.1% to UK GDP by 1800, with the main benefits only coming later in the 19th century as steam horsepower built up.
A more positive productivity period for the UK was the mid-19th century era when GDP per capita growth accelerated notably, boosted by the development of railways. Encouragingly, this period of faster productivity growth also lasted for several decades. Some estimates suggest railway developments might have added 9%-19% to UK GDP by the late 1860s. Certainly this was a transformative technology with major spillovers as rail freight rates in 1870 were in real terms just a tenth of road freight rates in 1800. Here too, though, there are some cautionary notes from history. Again, the benefits in terms of productivity took time to accrue, only becoming very strong by the mid-1850s (the first railway having opened in 1825) and then tailing off from the mid-1870s. The pace of productivity growth, while somewhat faster than in the first phase of the industrial revolution was also not very dramatic, averaging 1.2% per year in 1830-1876.

**The US 1917-1931.** As Ferguson notes, the late 19th century saw important technological advances in the form of the internal combustion engine and electrification, plus the telephone and office machines. These contributed to a strong rise in US productivity growth, but once again the impact was delayed. The acceleration in productivity growth is only visible from 1918 onwards, with productivity growth rising above 3% per annum. A key reason for this was the slow diffusion of the technology through the economy, with one estimate suggesting around half of US manufacturing plants were not electrified until 1919 – some 30 years after the technology came into being. Moreover, the period of strong productivity growth in 1918-1929 again gave way to a period of much slower growth in the 1930s (Chart 5).
The UK in the 1980s: The UK enjoyed a pick-up in total factor productivity growth in the 1980s, improving from 0.5% per year in 1960-1981 to 1.4% in 1982-1990 (Chart 6). However, it wasn’t technology-led, being more to do with a variety of structural economic reforms and a shake out of inefficient practices in industry, although the latter may have speeded the adoption of some new techniques and technologies. Moreover, the uplift to productivity was short-lived, with TFP growth trending back down to its previous level in the 1990s. Much of the gains in the 1980s may have been one-off level effects.

Chart 6: The UK productivity boost in the 1980s was fairly short

The ICT boom of the 1990s and early 2000s: From the mid-1990s through the 2000s, the US saw a notable rise in labour productivity growth which averaged 2.3% per year from 1996-2010, versus 1.5% per year in 1970-1995 (Chart 7). The key factor behind this was the ICT boom. This perhaps looks like the closest historical parallel to the AI boom now being predicted by some observers. But it was less impressive than it might first appear.

Chart 7: Productivity benefits from the ICT boom didn’t last and were mostly in the US

First, it was again a case of the productivity effect being very delayed. The first computers were invented in the 1940s and integrated circuits in the 1960s. But in the 80s and 90s economists like Bob Solow (‘You can see the computer age everywhere but in the productivity statistics’) were puzzling about the apparent lack of impact of this technology on productivity. In addition, the rise in US productivity growth was relatively moderate and didn’t last long – productivity reverted to a weak trend in the post-GFC period, with the slowdown actually beginning before this.
Importantly, the productivity boom wasn’t really replicated worldwide either, with Europe notably missing out. While Europe’s ICT industry did enjoy a strong rise in productivity growth, the spillovers to the broader economy were more muted. Fernald et al. identify a lack of capital deepening as a key factor that muted the impact of the ICT boom in Europe.

What does this mean for AI’s productivity-boosting potential?

AI is a general-purpose technology (GPT) that promises potentially big productivity gains in specific industries. Brynjolfsson et al. point to some emerging evidence for gains in individual sectors, with AI potentially raising labour productivity by 14% in the customer service sector. It’s also easy to imagine big productivity uplifts from areas like autonomous vehicles. But our historical evidence strikes a note of caution about extrapolating dramatic rises in economy-wide productivity growth from the adoption of AI. A key issue is how fast this technology will diffuse through the economy. We have seen that new technologies sometimes take decades to bear full fruit and as Crafts notes, the literature on GPTs suggests that initial impacts of these technologies on growth can be small or even negative.

It takes time to transform a capital stock given that annual investment is only a small fraction of the total. New technologies may require heavy investment in new equipment to yield benefits, plus significant complementary investments (including in human capital, e.g. training) too. Some firms may be reluctant to engage in costly new investment if it’s not rapidly profitable. As a result, sometimes productivity improvements from a new technology are initially focused narrowly on the production of equipment embodying it, meaning the spillovers are limited (as was initially the case with ICT).

AI is unlikely to be very different, with substantial investments necessary in specialised hardware, software, and training to reap the benefits. These are costs that some firms may not wish to bear initially, and which may be prohibitive for others (including in poorer economies). Optimists argue diffusion could be much faster today with a more interconnected global economy. But there are many barriers to the diffusion even of existing tech, due to costs, regulatory issues, and cultural and language issues.

Even when the benefits do flow through, we can’t be sure they will endure. It’s one thing to yield increases in productivity levels for a given industry or even a whole economy, but another to permanently raise the rate of productivity growth. In the case of AI, a permanent boost probably rests on whether the use of AI leads to sustained improvements in the rate of innovation.

Finally, we should remember that some technologies that looked very promising when they first emerged have disappointed. Supersonic jets failed as a commercial proposition and nuclear power was never the ultra-cheap transformative technology that was hoped for (fusion remaining distant). Some of the remarkable recent improvements in areas like mobile phones have also done little yet to boost broader productivity. Maynard Keynes in the 1930s speculated that the rate of technical progress would leave us all leading lives of ease by now, with all our material wants satiated. This hasn’t proved to be the case.