

# Introducing *Welcome to the machine*

9 February 2023

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Andrew Harris

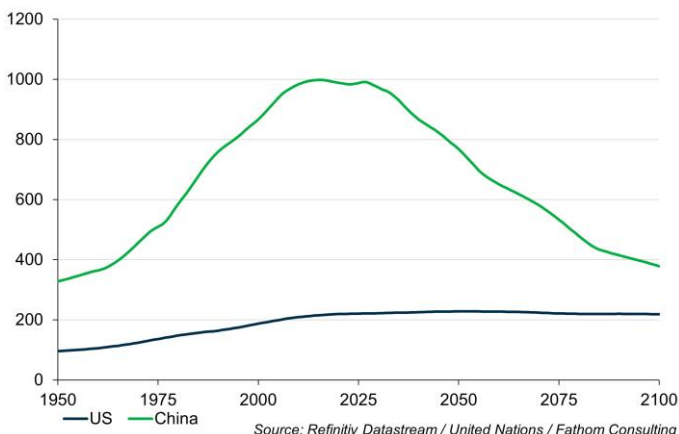


- Our pioneering report, *Welcome to the machine*, assesses the state of techno-economic competition between the US and China — this note summarises the report’s findings, and is the first in a series that will explore its conclusions in detail
- The report finds that the US remains the world’s largest and most influential economy and continues to represent the technological frontier, although China has been catching up on both fronts
- But unless something changes, that catch-up will end: China’s demographic dividend is over, and its productivity growth is expected to slow as it approaches the middle-income trap
- Technology could be that something, especially if it breaks the link between demographics and economic growth
- The US appears to have the edge in its techno-economic rivalry with China, but to maintain its lead it needs to be pedal-to-the-metal in driving further innovation
- A fourth industrial revolution, powered by artificial intelligence, could greatly affect the demand for and supply of labour

Techno-economic competition between the US and China is likely to dominate macroeconomics, geopolitics and financial markets over the coming decade and beyond. For now, the US remains the world’s largest and most influential economic power, although China has been catching up at a remarkable rate. Traditional macro models will tell you that, if this catch-up is to continue, it will depend on the outlook for two variables — the size of each country’s labour force, and how productive that labour force is. While China has the larger labour force, persistently low birth rates mean that its demographic dividend is at an end, with its working-age population expected to shrink. China’s productivity growth is also expected to slow within a decade as it struggles to break free of the middle-income trap — typically, only democracies and resource-rich countries have achieved productivity levels comparable to the US.

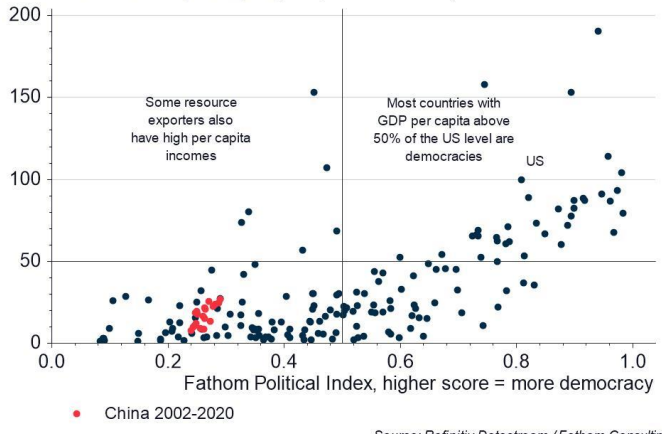
## China and US working-age population

Millions aged 15-64, including UN baseline projections



## Fathom Political Index and GDP per capita, 2020

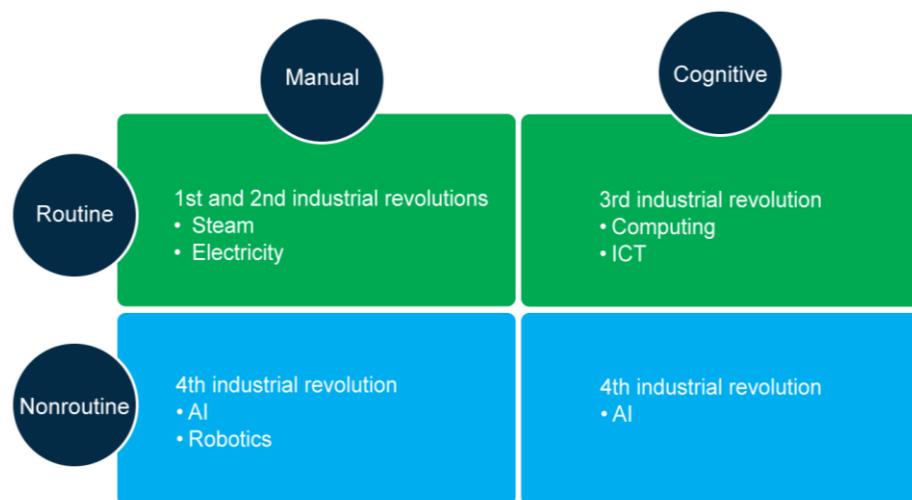
Per cent of US GDP per capita (PPP, IMF estimates)





Emerging technologies could be game-changing if they can reduce the reliance on labour as a factor of production. As with everything in economics, this has two elements — demand and supply. There is significant and well-documented debate about whether technology reduces the demand for labour, although it should be noted that employment today is as high as it has ever been (which suggests that historically it has not reduced labour demand, at least in the aggregate). However, the past is not always a perfect guide for the future. The standard framework for considering the labour-market impacts of automation is provided by Autor et al. (2003), who split jobs along two axes — whether they are routine or not, and whether they require cognitive or manual skills. To date, it has predominantly been ‘routine’ jobs that have been automated. AI could in theory change that by enabling the automation of nonroutine jobs too. So, this time could be different.

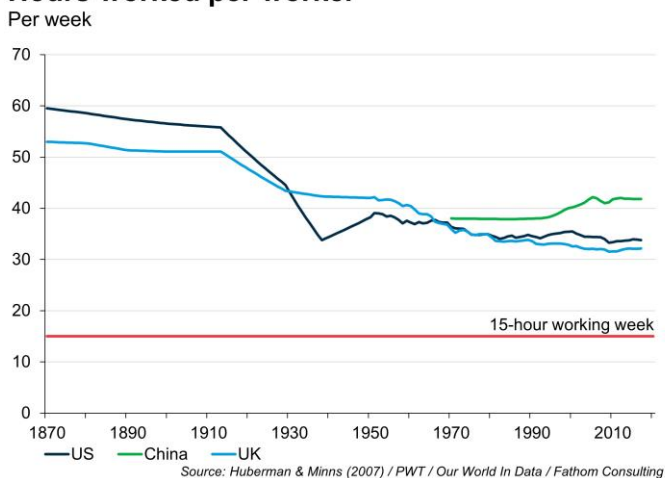
### A framework for the labour market impacts of automation



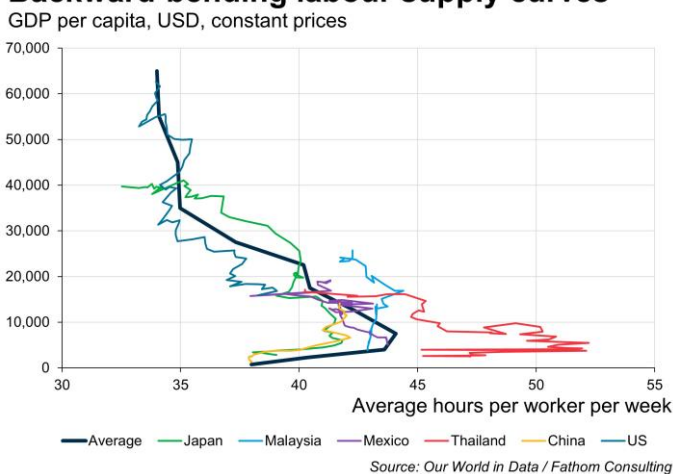
Source: Autor et al. (2003) / Fathom Consulting

However, the implications for labour supply are often overlooked, despite being equally important, in our view. Writing in 1930, Keynes speculated that by 2030 the working week might last as little as 15 hours, as higher hourly wage rates would lead to a preference for fewer working hours and more leisure time. It is unlikely that this will be realised by the end of the decade, but hours are certainly heading in that direction. Moreover, this is not purely a US phenomenon — as shown in the chart below, it seems that hours worked tend to fall as income per head rises above \$10,000. If future waves of technological innovation deliver higher wages (note: wages largely reflect the productivity of workers), then it is likely that hours worked will continue to fall. However, in this world, less labour is good, since it is driven by the preferences of workers.

### Hours worked per worker



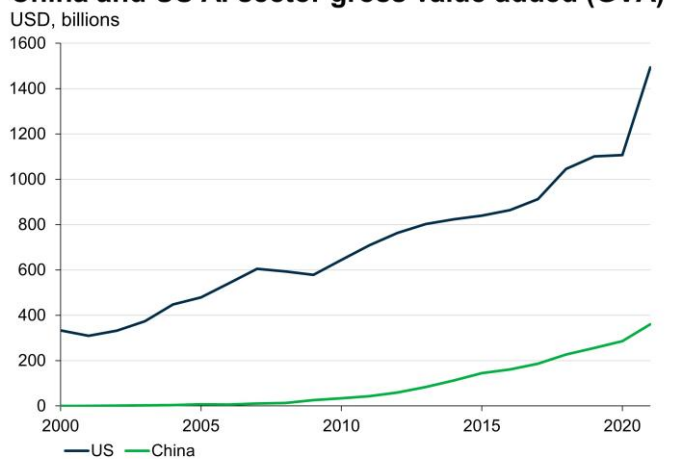
### Backward-bending labour supply curves





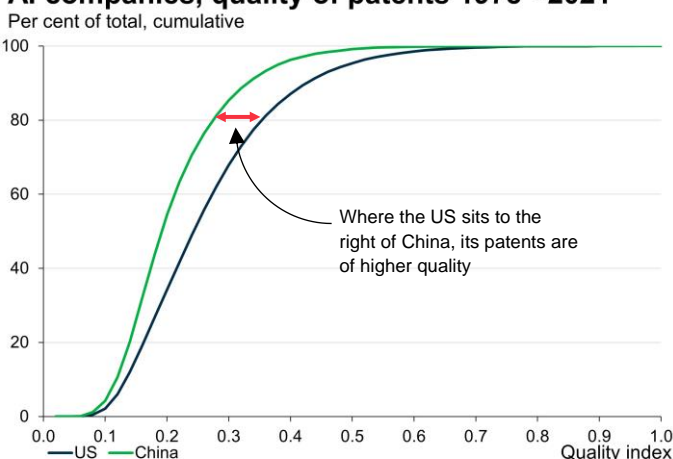
If artificial intelligence is to drive the next industrial revolution, investors and policymakers will need to know where that technology is likely to be developed. To that end, Fathom has produced what we believe to be the first comprehensive estimates of the size of the AI sectors in the US and China. We estimate that the US remains the technological frontier in AI, with its companies spending more on R&D, filing higher quality patents and attracting the best talent. Moreover, our proxies suggest that these companies contribute substantially more in terms of economic output than their Chinese peers. However, while China generally remains behind the frontier, it is catching up; and in some closely related areas (e.g., robotics and drone technology) it has arguably surpassed the US.

### China and US AI sector gross value added (GVA)



Source: Refinitiv Datastream / Fathom Consulting

### AI companies, quality of patents 1978 - 2021\*

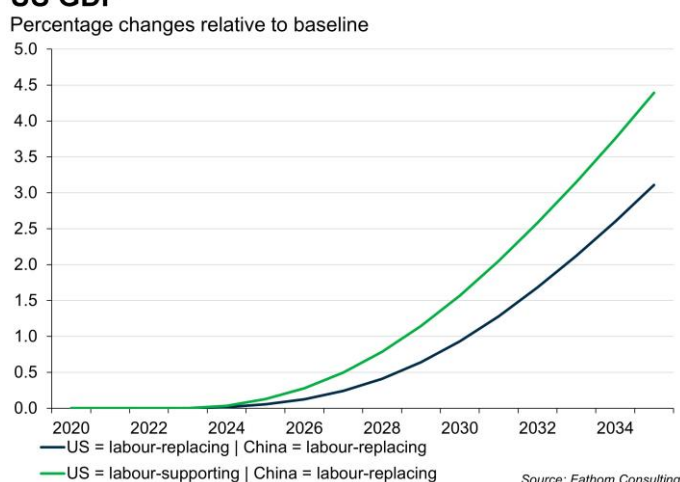


\*Using four component measure of quality

Source: OECD / Fathom Consulting

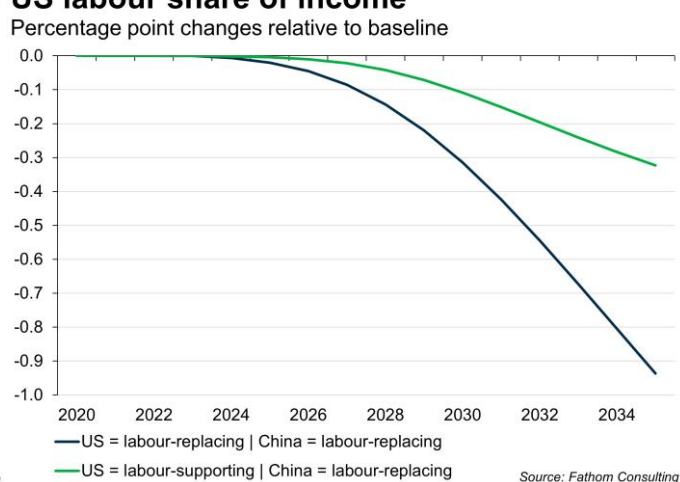
We expect the fourth industrial revolution to look very different for the US and the PRC. The rapid reversal in China's demographics suggests that it is likely to focus on developing technologies that replace human labour in the production process. For the US, our macroeconomic 'AI-robot model' (ARM) finds that better medium-term outcomes are achieved, in terms of higher output and lower inequality, through investing in technologies that support workers rather than attempting to replace them. However, at longer horizons (i.e., beyond 2035) this result flips, and US output will rise by more if it invests in labour-replacing technologies. Intuitively this makes sense, given that a) these technologies could break the link between labour and output, and b) we know that average hours worked fall as income rises.

### US GDP



Source: Fathom Consulting

### US labour share of income



Source: Fathom Consulting



This leads us to the key conclusion from this project. Right now, we stand in the foothills of the fourth industrial revolution. The speed of technological advance over the coming years is likely to be rapid, and the implications for growth are overwhelmingly positive — if the opportunities can be grasped by policymakers and industry now. The speed and impact of this change will be profoundly disruptive for global politics and for the structure of the labour market. Now is the time for the US and other western economies to start designing the policy mix that will best support and accommodate those changes, without, for example, creating substantial involuntary unemployment.

The US needs to invest both in technology that supports labour and in technology that replaces it. The right mix between the two will see automation step in and replace labour at the same rate at which workers voluntarily reduce their hours in response to higher hourly rates.

If the US wishes to remain ahead of China technologically, then public policy should incentivise the private sector to invest aggressively in further innovation. Policies aimed at de-risking private R&D, public-private partnerships and favorable taxation can all help to achieve this.

## ***Welcome to the machine***

*A comparative assessment of the USA and China to 2035, focusing on the role of technology in the economy*

This note is the first in a series highlighting the findings of *Welcome to the Machine*, Fathom's recent report on techno-economic competition between the United States and China to 2035.

[Read the report in full](#)

### **Further reading**

[The changing China consensus](#)

[Making the case for a UK industrial strategy](#)

[China is not about to drive up global inflation](#)

[Does China threaten US hegemony?](#)



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