NZIER INSIGHT

119-2024

NZIER PUBLIC GOOD PROGRAMME

THINKING ABOUT AOTEAROA NEW ZEALAND'S FUTURE

How could generative AI transform our economy?

Part 1: Economic theories and emerging evidence

With the rapid spread of ChatGPT over the past two years, generative artificial intelligence (AI) is taking the world by storm.

This is the first of two papers on the potential economic impacts of this powerful new technology. This paper discusses the economic theories and emerging evidence, and the next paper considers possible future developments and implications for New Zealand.

What is generative AI?

AI is a broad term that encompasses a range of technologies. It refers to systems that enable computers to perform tasks that traditionally require human intelligence, such as understanding language, analysing data, identifying patterns, and making predictions.

AI research began in the 1950s, but progress was initially slow. The development of machine learning led to early commercial applications in the 1990s and 2000s. AI became widespread following the deep learning revolution in the 2010s, which saw applications in virtual assistants, online shopping, and autonomous vehicles.

A significant breakthrough came in the early 2020s with the advent of generative AI, driven by the development of the transformer architecture. Generative AI is a type of AI that uses deep learning to create new content by generalising from existing data. The most well-known example is ChatGPT, released in late 2022. Generative AI can be used to generate text, translate languages, write code, and create art and music. It has accelerated the adoption of AI as it is cost-effective, easy to use, and widely applicable.

Why study its economic impact?

New technologies drive economic growth, enabling better standards of living. While technologies grow the size of the economy, they also lead to major changes in its structure. These changes can harm certain groups and exacerbate inequalities.

In 19th century England, the spread of automated textile machinery threatened the jobs of skilled workers. In response, a group of workers – known as the Luddites – raided factories and destroyed machines.

Generative AI is being developed and adopted much faster than earlier technologies, and it could have major disruptive effects on large numbers of people. It is important that we take time to consider what the impacts might be – both positive and negative – and how they can be managed. The aim should be to embrace AI's potential for growth while proactively addressing any negative effects.

This *Insight* briefly outlines economic theories of technological change and their implications. We then discuss the emerging empirical evidence on the impacts of generative AI. It covers similar theories and evidence to a recent Treasury report (Nicholls and Mukherjee 2024) but provides a different view on their implications.

Economic theories of technological change

We begin by considering some major theories of technological change and what they might mean for AI technologies (including generative AI).

AI could drive broad productivity growth

The concept of General Purpose Technology (GPT) was introduced by Bresnahan and Trajtenberg (1995). A GPT is a technology that is used pervasively across a wide range of sectors, is capable of ongoing technical improvements, and enables complementary innovations. Examples include the steam engine, the electric motor, and computers.

Bresnahan and Trajtenberg (1995) argue that GPTs drive broad productivity growth over long periods by enabling new production methods across the economy. There can be an initial lag before growth occurs as it takes time for GPTs to improve and become affordable, for complementary innovations to happen, and for businesses to re-organise production around the new technology.

If AI is a GPT, as some economists suggest (e.g. Deming, Ong, and Summers 2024), then it will eventually become widespread and have a significant effect on productivity growth. However, it could take several years or decades before we feel their effects.

It could also speed up innovation

An invention of a method of inventing (IMI) is a concept introduced by Griliches (1957) to describe hybrid corn. Hybrid corn was not a single invention that could immediately be implemented everywhere. Instead, the actual breeding of adaptable hybrids had to be done separately for each location. Once the method of hybridisation was established, it led to a new period of systematic innovation in agriculture.

Like hybrid corn, AI opens up new opportunities for research innovation. Unlike hybridisation, AI has applications across a wide range of industries. Based on this logic, economists have argued that AI may be both a GPT *and* an IMI (Crafts 2021; Cockburn, Henderson, and Stern 2018).

Technologies that are both GPTs and IMIs involve new approaches to innovation that can be widely applied across the economy. Recent work suggests that productivity growth has slowed down because ideas are becoming harder to find (Bloom et al. 2020), raising the possibility that generative AI could provide a much-needed way out.

New technologies tend to favour skilled workers

The theory of skill-biased technological change posits that technological advancements tend to favour skilled workers over unskilled workers (Autor, Katz, and Krueger 1998). New technologies often require higher levels of education, training or skills to use, raising the demand for skilled labour relative to unskilled labour. As a result, skilled workers' wages rise faster, leading to greater wage inequality.

Skill-biased technological change explains why wage inequality has risen in many countries in the late 20th century alongside the advent of computers and information technology, with studies showing that demand for skilled workers has grown faster in more computer-intensive industries. If AI is also skill-biased, then it will benefit highly skilled workers more than low and middle-skilled workers, potentially leading to greater polarisation in the labour market.

The effect of AI depends on the tasks it will replace and create

The task-based approach argues that jobs are composed of tasks, and the impact of new technologies depends on the types of tasks they will replace. It was introduced by Autor et al. (2003), who argued that computerisation increases the automation of routine tasks, raising demand for workers performing non-routine tasks. This explains why new technologies have tended to be skill-biased.

More recently, Acemoglu and Restrepo (2019) presented a task-based model where technological progress not only automates existing tasks but also creates new tasks. The overall impact depends on the balance between two effects:

- **Displacement** – machines taking over labour-intensive tasks, leading to job losses and lower wages.
- **Reinstatement** – the creation of new labour-intensive tasks, leading to new jobs.

The task-based approach suggests that the effect of AI depends on the complex interplay of several interrelated forces, making it difficult to predict. The reinstatement effect could occur more slowly than the displacement effect, potentially leading to a temporary decline in labour demand that could last for several decades.

Emerging empirical evidence on the impact of generative AI

Having discussed key theoretical frameworks, we now turn to the emerging empirical evidence on the adoption of generative AI and how it is influencing productivity and employment.

Adoption is occurring much faster than earlier technologies

A recent US survey found that generative AI has been adopted by 40 percent of the working-age US population after just two years – double the 20 percent rate achieved by the internet over the same period (Bick, Blandin, and Deming 2024). Similarly, a survey of 100,000 workers from selected operations in Denmark in late 2023 found that half have used ChatGPT, and a third currently use it (Humlum and Vestergaard 2024).

These two studies show that generative AI is used by workers in a broad range of occupations to perform many different workplace tasks, suggesting that it is a GPT.

Both studies also found that adoption is higher among younger, more educated, and higher-income workers. There is also a large gender gap, with men significantly more likely to use generative AI than women. These results support the idea that generative AI is skill-biased and could exacerbate inequalities.

The Danish study showed that workers' use of AI was correlated with their views about the potential for AI-related productivity improvements, implying that adoption is affected by individual beliefs (Humlum and Vestergaard 2024). Workers say that the primary barriers to adoption are restrictions on use and the need for training. Few workers fear becoming dependent on technology or redundant because of it.

Adoption in New Zealand appears relatively high. A Microsoft survey found that 84 percent of knowledge workers use generative AI at work, compared to 89 percent in Australia and 71 percent in the US (Microsoft and LinkedIn 2024).

Attitudes appear to be a barrier to adoption. Two-thirds of New Zealanders say AI makes them nervous, making us the country with the second highest level of concern (Ipsos 2024). Similarly, more than two-thirds of New Zealanders are concerned that it will be used maliciously, be unregulated, or have unintended consequences (Matika 2023).

AI increases productivity for many tasks

Recent studies suggest that generative AI can significantly increase productivity across a range of tasks, including writing, customer service, and programming. ChatGPT helps university-educated workers complete professional writing tasks 40 percent faster and improves quality by 18 percent (Noy and Zhang 2023). Customer services workers using generative AI can resolve 15 percent more issues per hour on average (Brynjolfsson, Li, and Raymond 2023). Access to generative AI enables software developers to complete programming tasks 56 percent faster (Peng et al. 2023).

In all these studies, generative AI tools have a bigger impact on the productivity of workers who were less productive to begin with, implying that AI has the potential to decrease inequality if everyone adopts it.

There is also evidence that generative AI speeds up innovation. A recent study of materials scientists in a large US firm found that AI-assisted researchers discover 44% materials, resulting in 39% more patent filings (Toner-Rodgers 2024).

In New Zealand, ACC has found that four-fifths of their workers who use Microsoft Copilot find the technology boosts the quality and speed of their work (Pennington 2024). It also improves employee wellbeing and benefits people with ADHD, poor hearing, and dyslexia.

Based on an analysis of the tasks performed by New Zealand workers and how they might be impacted, Accenture has estimated that generative AI could increase labour productivity growth in New Zealand by 1 percentage point a year, adding $76 billion to GDP by 2038.

Labour market impacts remain unclear

A large-scale representative survey of US employers in 2023 and 2024 found that 27 percent of firms that use AI are using it to perform tasks previously done by workers, but only 5 percent have changed employment (Bonney et al. 2024). These figures are expected to rise to 35 percent and 12 percent, respectively, in the near future, implying that it will take time for AI to impact jobs. A slightly higher fraction of firms report or expect an increase in employment rather than a decrease, indicating that the reinstatement effect could outweigh the displacement effect.

In a recent New Zealand survey, although 96 percent of firms said that AI has made workers more efficient, only 8 percent said that AI had replaced employees. (AI Forum NZ 2024). Twenty-nine percent said that AI has resulted in less need to hire employees, and 39 percent said AI had created new career opportunities for their workers.

Deming, Ong and Summers (2024) develop a model of churn for the US labour market churn. The years from 1990 to 2017 were the least volatile since data began in 1880, but churn since 2020 has been very high by historical standards. These authors argue that AI is leading to a period of pronounced disruption in the labour market.

Putting theory and evidence together

Combining the economic theories with the empirical evidence yields three main conclusions:

- The rapid rate of adoption coupled with large productivity gains indicate the potential for major increases in economic growth. If AI is both a GPT and an IMI – which seems likely – it could speed up innovation, addressing the slowdown in productivity growth that has occurred in recent decades. However, it could take several years or even decades before the effects begin to be felt.
- The adoption of generative AI is unequal, indicating that it could be a skill-biased technology that exacerbates existing inequalities. On the other hand, generative AI tends to provide greater productivity improvements for workers who earn less, to begin with, implying that it could also have an equalising effect if used by those workers with the most to gain.
- It is too early to say whether generative AI will ultimately create as many jobs as it destroys. So far, there is no evidence of widespread job loss due to AI. However, it will take time for the full labour market impacts to be felt. There will be a high degree of churn as the economy adjusts and workers change roles.

In summary, theories and evidence indicate that generative AI could have major impacts on a scale similar to steam power, electricity,

and computing. As with these earlier technologies, the impacts are likely to unfold gradually over time.

In our next paper, we consider how generative AI could develop in the future and what New Zealand can do to prepare.

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How to cite this document:

Katz, A. 2024. How could generative AI transform our economy? Part 1: Economic theories and emerging evidence. NZIER Insight 119. https://www.nzier.org.nz/publications/how-could-generative-ai-transform-our-economy-part-1-economic-theories-and-emerging-evidence-nzier-insight-119

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