Making the most of the AI opportunity

Research paper 1

AI uptake, productivity, and the role of government

Contents

The Productivity Commission acknowledges the Traditional Owners of Country throughout Australia and their continuing connection to land, waters and community. We pay our respects to their Cultures, Country and Elders past and present.

The Productivity Commission

The Productivity Commission is the Australian Government's independent research and advisory body on a range of economic, social and environmental issues affecting the welfare of Australians. Its role, expressed most simply, is to help governments make better policies, in the long term interest of the Australian community.

Further information on the Productivity Commission can be obtained from the Commission's website (www.pc.gov.au).

AI uptake, productivity, and the role of government

Key points

※ **Artificial intelligence (AI) technologies should increase productivity across the economy – although as with other general-purpose technologies, it will take some time before the effects are observable in aggregate productivity data.**

- Investment in complementary inputs such as managerial changes, training and business processes are needed for productivity gains. These investments can be many times the magnitude of the initial technology investment and deliver benefits several years later.
- Adjustment and experimentation is needed, but over time AI could significantly improve the productivity of the services sector, which has a history of poor productivity growth.

※ **Australian businesses are already using AI technologies through existing software and services.**

- Much AI uptake is 'by default' – through updates to existing software and via outsourced services. This will lead to small, ongoing productivity gains across many firms – which could be substantial in aggregate but difficult to attribute to AI.
- For most businesses, human decision-making is being assisted by AI (a co-pilot model), although the level of human oversight may decrease as AI accuracy and capabilities increase over time.
- Larger productivity gains through transforming core business and taking up complementary technologies could be slower and will depend on industry features (which government can influence) such as data quality and availability, regulation, investment climate, competition, as well as broader features such as public acceptance.

※ **Focus is needed on policy interventions that effectively support safe AI uptake and productivity – particularly governments leading by example in their AI procurement and use.**

- Governments need to lead by example in AI procurement and use, and by increasing the safe sharing of data that is needed for AI applications.
- Development and uptake of AI by the private sector will largely happen without direct government assistance. But governments need to get regulation right (Paper 2, *The challenges of regulating AI*) and improve secure access to data and incentives for data quality (Paper 3, *AI raises the stakes for data policy*).

Artificial intelligence (AI) is one of the technologies at the heart of the latest technological revolution. While the term 'AI' is extremely broad and often poorly defined, the AI models that have emerged in recent years apply advanced machine learning to increasingly sophisticated uses, including natural language processing, image recognition, recommender systems, personalised search and social media.[1] These models make use of previous and concurrent waves of technological innovation, including computing power, connectivity, and big data. By harnessing such innovations toward productive ends, AI technologies increasingly show potential in undertaking complex tasks that were outside the scope of previous waves of automation.

Will AI drive a sustained uplift in productivity across the economy? If so, when will we start to see evidence of that and what can governments do to increase the chances of our economy benefiting from AI?

Experience with the internet, personal computers, and other technological disruption shows that disruptive business models can quickly become a normal part of life, but the process of adjustment – in terms of policy, regulation, and structural adjustment – is not straightforward. While technological advancement over time has tangible effects on our lives, it can be difficult to identify their implications for productivity.

Like previous waves of technological disruption, AI has begun to raise both opportunities and challenges.

First, the scale of its impacts is potentially significant. Machine-learning models are already beginning to automate complex productive processes which were invulnerable to previous waves of automation. These models have potential as general-purpose technologies (similar to electricity, computing, and the internet).

Second, it presents new complexities and risks. AI will have implications for trustworthiness, liability (and safe harbour) and raise questions about the treatment of technology as legal entities. The ability for technology to make reliable predictions or solve complex decisions based on vast amounts of data can mean that it is difficult (or impossible) to trace how such decisions were made – presenting a 'black box' for users, consumers, or even developers.

Third, the uptake of AI technologies could occur in waves. As general use technologies, forms of AI could be applied in numerous ways across different occupations and sectors, and spawn a variety of complementary innovations. It could also lead to push-back by those whose businesses or employment is disrupted by AI-based innovations. Given the state of digitalisation of the Australian economy, uptake could occur at scale across multiple sectors at different times, resulting in sequential disruption across the economy.

So what role should Australian governments play at this stage of AI uptake and development?

The Australian Government (2024) has noted that it will consider opportunities to 'ensure that Australia can maximise the benefits' of AI (p. 25). In this paper, the Productivity Commission finds that some forms of AI are already pervasive across the economy and society (including in internet search, mapping, and word processing) requiring no further policy intervention. However, broader uptake and deeper integration of AI into productive processes could be assisted by a number of policy interventions, primarily those related to building trustworthiness, leading by example, reducing uncertainty, building foundational capabilities, and setting appropriate access to data.

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[1] AI for the purpose of this paper should be distinguished from artificial *general* intelligence, which has not yet been developed and is outside the scope of this paper that considers uptake of existing AI technologies. Machine learning is a subfield of AI that describes algorithms which are capable of completing a task with minimal human instruction. Often these algorithms 'learn' to accomplish the task by being trained on example data.

1. The importance of AI uptake to Australia's productivity

While recent developments in AI technologies have sparked renewed policy interest, the term 'AI' arguably encompasses technologies that have been used throughout the computer age, and more intensely with the rise of internet connectivity, wide-scale digitisation, and big data.[2] Recent advances in machine learning have given rise to algorithms that are capable of solving increasingly difficult real-world problems. These recent applications of AI present transformative potential for productivity and challenges for policy.

What benefits could AI offer Australia?

As a form of (intangible) capital, investments in AI increase the amount of capital per worker and could improve labour productivity by increasing the amount of output each worker is able to generate. AI could also, in time improve labour productivity through increases in the overall efficiency with which the components of production are used together – by enabling improvements in managerial practices, organisational change, economies of scale, network effects and general knowledge.

AI has the potential to address some of Australia's most prominent and enduring productivity challenges. For instance:

- Australia experiences **skill and labour gaps** in a range of occupations – where skills are in global shortage, or where market wages are unable to clear (such as in publicly-funded services). AI has shown potential to augment labour in skilled and knowledge work, opening new opportunities for automation (in part or full) and smarter use of the limited workforce.[3]
- More broadly, AI could improve **productivity in services**. Given that services account for 80% of GDP and 90% of the workforce, productivity growth for Australia as a whole relies crucially on getting better productivity across the services sector (PC 2022b, p. 28). Broadly, the development of large language models and generative AI is increasingly showing potential to improve productivity (including through improved quality and customisation) in some forms of services.[4] Recent improvements in generative AI are expected to present opportunities for innovation in publicly provided services such as healthcare, education, disability and aged care, which not only account for a significant part of the Australian economy but also traditionally exhibit very low productivity growth.[5]

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[2] The OECD defines an AI system as 'a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. Different AI systems vary in their levels of autonomy and adaptiveness after deployment' (OECD nd).

[3] Some consider that AI will change the historical relationship between technological advancements and labour demand, by replacing non-routine tasks in high-skilled occupations (Ernst, Merola and Samaan 2018; US-EU TTC 2021).

[4] Generative AI expanded the set of tasks AI could automate in service-based occupations such as education, creative occupations and business and legal professions. In the education sector, AI has been used to generate personalised feedback for students, real-time evaluation of educational outcomes and personalised learning plans (Islam 2023; Liu, Chen and Yao 2022; Rizvi, Waite and Sentance 2023). AI could generate significant productivity gains in those parts of the services sector where productivity growth is traditionally sluggish (AI may be used to personalise service offerings and recommendations based on consumer preferences, past behaviour and demographics in industries like hospitality, food and accommodation services (Hollander 2023)).

[5] The Commission's Productivity Review identified large potential gains from even modest innovations in government-funded and managed services, given total general gross government expenses at the local, state and territory and Australian level are around 42% of GDP, with the biggest potential savings arising from efficiencies in delivery of government services to the community (22% of GDP) (PC 2023d, p. 58).

- By increasing the productivity of knowledge workers, AI could accelerate **innovation** and future productivity growth (Baily, Brynjolfsson and Korinek 2023). With the capacity for machine learning systems to process large volumes of data and reveal patterns and insights that could improve **research and development capabilities**, leading to more rapid innovation and diffusion.[6] This could be particularly valuable for tackling large scale problems that require rapid innovation such as the move towards a decarbonised economy.
- To the extent that AI technologies can automate processes usually undertaken by workers, this could provide incentives for firms to employ more technology and equipment relative to labour (capital deepening). In other cases, the ratio between labour and capital may remain constant (such as for jobs where each worker has one computer) and advances in AI could make the same combination of labour and equipment more productive (improving multi-factor productivity). Both processes improve labour productivity.

At this stage of development and AI uptake, it is impossible to know to what extent AI will deliver on its potential. Achieving productivity gains will depend on how the technology and complementary technologies continue to develop, and how successfully these are adopted and applied. It will also depend on how government policy around AI regulation and data develops.

In some ways, Australia's economy is well-placed to harness the productive potential of AI. AI uptake typically requires the integration of other technologies, and the productivity benefits of AI often accrue to firms that use other advanced technologies and ICT skills (Calvino and Fontanelli 2023). Australian businesses are moderate or fast adopters in some areas of technology, for instance, with 59% of businesses using cloud technology in 2021-22 (ABS 2023) (although uptake of other advanced digital capabilities has lagged in comparison with other countries). Digitisation has also increased in recent years, accelerated by the COVID-19 pandemic (PC 2022a, p. 9).

Is AI already leading to productivity gains?

Controlled experiments find substantial productivity gains associated with workers using AI for specific tasks (with increases both in quality of output and speed). Software engineers, for example, coded up to twice as fast using an AI-based tool (Kalliamvakou 2022); professional writing tasks were completed significantly faster (Noy and Zhang 2023); and call centre operators became 14% more productive using AI tools (Brynjolfsson, Li and Raymond 2023). Such studies commonly find productivity gains are highest for the least experienced or productive workers (Brynjolfsson, Li and Raymond 2023; Noy and Zhang 2023). A study evaluating whether an AI-based algorithm could outperform medical students' audits of a neurosurgical ward found the algorithm produced significantly more recommendations, in a shorter time and with greater factual accuracy (a 0% error rate) than the students using the same dataset (Brzezicki et al. 2020).

But in real world settings, despite positive relationships between AI uptake and firm productivity, there is scant empirical evidence that AI uptake causes an increase in firm productivity (OECD 2023). Studies of AI-using firms find links between AI use and productivity (Calvino et al. 2022; Calvino and Fontanelli 2023) but it is not clear that the relationship is causal (for example, it may be that more productive firms self-select into AI use). Limited firm-level data, sample sizes and endogeneity issues are general challenges for research on the relationship between AI adoption and firm productivity.

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[6] The ability for AI to 'learn' quickly from large datasets can reduce uncertainty in experimentation and increase the efficiency of the 'learning process' (Babina et al. 2021, p. 11). Early empirical evidence has established a positive link between AI and product innovation (indicated by patents, trademarks and updates to product portfolios) (Babina et al. 2021, p. 39).

Several studies identify productivity benefits for subsets of firms including larger firms (Babina et al. 2020; Bäck et al. 2022), non-early adopters (Bäck et al. 2022), and those with other existing modern technologies and ICT skills (Calvino and Fontanelli 2023).

Is the lack of productivity gains from AI concerning?

A lack of widespread measured productivity growth from AI adoption at this stage should not be cause for concern as the (potentially sizable) benefits of AI use would take time to eventuate. The absence of a clear productivity dividend from AI use in the statistics at this stage may be explained by the current ongoing development and uptake of AI and by the slow pace of technological diffusion. Technological innovations are often slow to appear in productivity statistics: it takes time to build a new technology to a size sufficient to have an aggregate economy effect. In the case of electrification, it took about two decades for productivity gains in industrial processes to be statistically evident (David 1990).

Even where technologies are adopted, it can take time for firms to harness their full productive potential. To make full use of a new technology, firms must develop new business processes and managerial experience, train workers, and build other intangibles, as well as develop any complementary technologies needed – all of which potentially require investments not readily measured in productivity statistics. With current productivity measurement methods, firms will be seen committing measurable resources and forgoing measurable output during the early adoption of technologies in order to build complementary inputs that may go unmeasured. After some time, these investments will begin to return measurable productivity benefits.[7]

The magnitude of complementary changes in business practices and other investments such as staff training have, with some past technological advancements, been many times the magnitude of the direct expenditure on new hardware and software (Brynjolfsson and Hitt 2003). Some larger firms may not only reconfigure their internal practices with new technology, but also aspects of their supply and distribution chains. The more profound and far-reaching the potential restructuring, the longer the time lag between the initial invention and the visible increase in productivity. These factors result in a J-curve of measured productivity growth associated with technological innovation.[8]

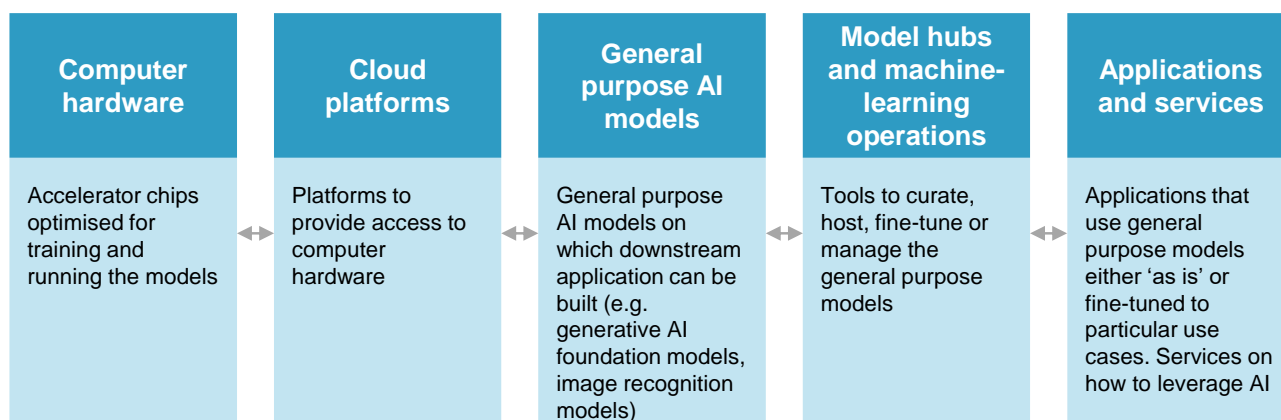## Australia's role in the AI value chain

While Australia's role in the global AI value chain is evolving – and will determine when we 'make' or 'buy' – this role needs to be driven by comparative advantage. Activist government 'sponsorship' of parts of the AI value chain is unlikely to yield ongoing productivity benefits, as Australian governments have limited scope to (positively) influence where Australia's comparative advantages lie.

The AI value chain (figure 1) includes the production of computer hardware, provision of cloud services, the collection and curation of data, the development and training of algorithms, and the integration and deployment of AI models into practical applications. Firms can provide any or all of these services, but the market for providing hardware, cloud, and foundation models is already concentrated, and likely to remain so.

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[7] A study by Brynjolfsson and Hitt (2003) found an increase in output contributions associated with computerisation over longer time horizons (between three and seven years) to be substantially (two to five times) greater than the short-run impact.

[8] The J-curve of productivity growth refers to the dip in measured productivity as firms invest and restructure to take-up new technologies followed by an uptick in productivity as the benefits of the new technology materialise (Brynjolfsson, Rock and Syverson 2017).

Figure 1 – AI value chain

Computer hardware	Cloud platforms	General purpose AI models	Model hubs and machine-learning operations	Applications and services
Accelerator chips optimised for training and running the models	Platforms to provide access to computer hardware	General purpose AI models on which downstream application can be built (e.g. generative AI foundation models, image recognition models)	Tools to curate, host, fine-tune or manage the general purpose models	Applications that use general purpose models either 'as is' or fine-tuned to particular use cases. Services on how to leverage AI

Source: Adapted from McKinsey and Company (2023).

Developing deep-learning AI models[9], such as foundation models, requires immense amounts of data[10], extensive computing power[11], and significant expertise. Only a handful of companies globally are currently able to meet these requirements. Companies that have already embedded AI capabilities are in a position to retain their market power through restricting access to their datasets and workers (the latter through non-compete clauses in employment contracts) (Leigh 2023). As such, there is likely to be significant concentration in the global market for hardware, cloud services, and developing advanced machine-learning models. It is unlikely that Australian policy or regulation can influence this market outcome.

Australia's comparative advantages are less likely to be in activities that require extreme quantities of data and investment. Rather, they could be in the development of AI models that can be trained on smaller (high-quality) datasets; or the adaptation of general-purpose models to more specific use cases, based on local data; or in uptake and implementation of the technology by digitised firms and through software as a service.

There may be a range of opportunities for Australian businesses to add value 'downstream'. How this manifests in practice also depends on the structure of AI supply chains (table 1). For example, while some Australian businesses might use systems built in-house, others rely on application programming interfaces (APIs) or have systems built or adapted for their purposes.

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[9] Such as models using the Transformer architecture, first presented in Vaswani et al (2017).

[10] Data is integral to developing an AI model – and often a high volume of quality training data is required. To date, a small number of companies have compiled sufficient datasets and expertise to develop 'foundation models'. And as generative AI systems learn from their users by observing which responses meet user demands, data network effects are likely to result in greater market power for incumbent data holders through learning-driven barriers to entry (Leigh 2023). Australian regulators have noted that firms with control over valuable data may have an incentive to entrench their 'data advantage' by actively restricting access to that data (DP-REG 2023, p. 5).

[11] Cloud and computing power needed to run AI are another potential source of market power. The global market for cloud services is dominated by a small number of large scale cloud providers – just three companies account for almost two-thirds of cloud infrastructure revenue, with the largest eight providers controlling almost 80 per cent of the market (Richter 2023). Likewise, the market for semiconductor chips – another key input in computing power – is also concentrated (Leigh 2023).

Table 1 – Examples of different supply chains

Category	Type of supply chain
Systems built in-house	1. [One actor] A company develops AI systems in-house, using their own staff, software and data.
Systems relying on an API	2. [Three or more actors] A developer company buys AI systems and components from several other companies, integrating them into a complete system of its own before supplying it to companies and end users directly or via an application programming interface (API).
	3. [Two actors] A company develops and trains an AI system which a second company accesses by sending queries via a limited API.
Systems built or fine-tuned for a customer	4. [Two actors] A company deploys a system custom-developed by another company under contract.
	5. [Two actors] A developer company sells a complete AI system to a second company, which inputs its own data to enable the system to undertake additional training, and deploys it. The developer has some control over the resulting system.
	6. A developer company sells a complete AI system, including direct access to the underlying model(s), which the second company can access and train using its own data. The developer has a low level of knowledge and control over the resulting system.
	7. An AI system developer sells code to a deploying company, which uses it along with its own data to train and deploy a specific type of model.

Source: Brown (2023).

Some stakeholders have argued for governments to support domestic capability in developing AI. From a productivity perspective, such a capability could be valuable if the expertise needed to develop new AI models is available to assist AI uptake by the majority of firms. For instance, a larger ecosystem with end-to-end support would aid in AI uptake (CSIRO 2023). In developing greater expertise and capability through supporting an AI innovation industry, skills and know-how could become available to other firms adopting AI further down the value chain. However, such spillovers are likely to arise from large international tech firms already operating in Australia. These global businesses have strong incentives to establish their platforms in Australia. Large US tech firms in particular already provide capital and technology, and global expertise (Accenture 2023, p. 7).

Some stakeholders have raised concerns regarding the geopolitical and national security implications of AI products and services provided by overseas firms.[12] It is beyond the scope of this paper to examine technical vulnerabilities related to national security; however, we note that this concern is not confined to AI.

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[12] AI's fundamental nature is a 'dual-use' technology, in that it can be used for both civil and military purposes. For example, chatbots based on large language models have both civil uses (writing and editing) as well as potential military uses (state-based hacking or information operations) (Keast 2023, p. 4). National security risks include risks to cyber security, critical infrastructure and social cohesion, and weapons proliferation and terrorism (Keast 2023, p. 4). Firms with state-based links may pose security risks to Australia, and necessitate identifying, triaging and managing risk (Gilding 2023, p. 4).

2.   AI is already spreading through the Australian economy

Productivity gains will be reliant on the rate of AI adoption. Take up of AI will likely be uneven across the economy, occurring in waves and progressing at different rates.

The rate of adoption for most innovative technologies follows a common pattern of slowly building, sharp uptick, then plateau (the technology 'S-curve').[13] Firms adopt at different points along the S-curve as their expected benefits of adoption begin to outweigh their expected costs (both of which are influenced by the technological, organisational and environmental factors unique to each firm and the nature of complementary technologies or products needed). In competitive markets the majority of firms may adopt new technologies in quick succession as their competitors begin to reap the productivity benefits of the new technology. Similarly, AI technologies can be expected to be adopted unevenly over time.

Early work by the OECD indicates that larger firms, firms with higher within-industry market shares, and firms using other digital technologies are more likely to use AI (OECD 2023). Early adopters of AI technology tend to include firms that have the most capability, as well as those with the most to gain. Firms that lag behind in adoption typically lack immediate commercial incentives to adopt technology, exhibit risk aversion, or face other regulatory or capability barriers. Many firms will likely be spurred on to adoption as others demonstrate the benefits of AI and start gaining a competitive advantage.

Because 'AI' is a broad term that applies to a wide range of applications, there are likely to be a series of S-curves across different industries and applications, following different rates of adoption. For example, AI-based chat bots have been adopted more rapidly than applications like autonomous vehicles, largely due to differences in complexity, cost, and risk. And the accessible nature of AI (particularly open-source AI models, and digital tools with AI embedded) could mean that uptake is rapid, unstructured and hard to measure. It is useful to consider the ways in which AI will be adopted, how this relates to differing diffusion paths from a productivity perspective, and what this suggests for policy approaches.

Many firms are already taking up AI – passively and at relatively low risk

At this stage, it is difficult to estimate economy-wide uptake of AI technologies, or to decipher what take-up rates might mean in practice.[14] Some surveys show that 72% of (a small sample of) Australian businesses report currently using AI (and 67% of the remainder plan to start using AI within the next two years) (Datacom 2023); 42% of Australian organisations report using AI in e-commerce (Technology Decisions 2023). There have been a few studies in recent years that have attempted to measure the rate of

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[13] The technology S-curve is the foundation of key theories of organisational and competitive dynamics and has been tested empirically (Gans et al. 2020, p. 8). Recent work by Gans et al. (2020) has understood the technology S-curve not as a technological given but as an envelope of potential outcomes reflecting differing strategic choices by the entrepreneur in exploration versus exploitation.

[14] The variation in estimates might result from sample size – the sample size of the three estimates varies from 200–7000 businesses. Too small a sample may prevent the findings from being extrapolated, whereas too large a sample may amplify the detection of differences, emphasizing statistical differences that are not relevant. Variation may also reflect uncertainty of definition – there may be a variety of assumptions made about what businesses understand by use of AI. Studies have found that business owners are often unaware that AI is already integrated in the software/technology they regularly interact with. However, according to recent survey data, businesses are now more aware of indirect use of AI in their workflow than they were in 2017 (HubSpot 2023).

AI adoption in Australia - and estimates vary widely. IBM (2022, p. 4) found 24% of Australian firms deployed AI in 2022, while CSIRO (2023) found over 44% of Australian businesses have already deployed AI into their operations. These two estimates stand in contrast to the ABS (2022) data that finds only 1% of Australian businesses have adopted AI.

As large software providers embed AI in their applications, large numbers of their business customers benefit from the functionality of AI in a relatively frictionless way. This pathway can be quick to reach many, often smaller, firms. It often requires no additional effort or cost or specialised skills to take up AI-enabled applications. Arguably, the vast majority of businesses with a threshold digital capability are already using AI without realising through their business software, digital advertising platforms and payments or banking systems.

This adoption pathway offers ongoing small productivity gains to each business (such as more streamlined accounting, better targeted marketing or improved logistics). But multiple small and ongoing productivity gains over a large number of firms and employees could add up to substantial productivity gains overall.

Passive uptake of AI technologies can allow larger businesses to manage risk on behalf of smaller clients, as technology companies regulate their ecosystems to protect their brand and reputations. To the degree that explicit regulation is needed to supplement internal business quality controls, a range of international regulations are likely to apply to multinational tech firms, which will flow on in some way to Australian firms operating in those environments.

As such, there is little role for Australian governments to create incentives toward this adoption pathway.

Industries and firms differ in how they incorporate AI into core business

Deeper and more deliberate AI uptake (such as automating operations, informing decision-making, and recruiting) will vary across different sectors and applications, depending on access to funding, sector-specific regulations, relative advancement of technologies, degree of digital literacy and sophistication of businesses, and degree of competition in a given market. Tolerance of risk also plays a large role in the timing and speed of AI adoption – for example, parts of healthcare will have a lower acceptance of errors from AI than marketing.

As noted above, competition will generally spur business AI adoption, so AI uptake could lag in less contestable markets (Andrews et al. 2022). Peer competitive pressure significantly influences firms' decisions to adopt AI (Bughin and Seong 2018). Firm-level dynamics are also likely to be important:

- Larger firms with ICT resources and skills have dominated early adoption (Calvino and Fontanelli 2023). These firms may have an advantage in attracting and retaining skilled labour.
- More digitally advanced businesses will be in a position to apply AI successfully.
- Firms unfettered by legacy ICT systems (such as new entrants 'born digital') may have an advantage.
- Access to high quality data, either in AI model training or for adapting and deploying a model on new local data, will give firms an advantage.

AI has value when it leads to better decisions. Industries and firms will differ in how AI will be used – and trusted – in decision-making processes, where one end of the spectrum is fully automated decision-making. Indications are that AI technology needs to considerably improve its accuracy and explainability before firms will trust it to make fully automated decisions in all but limited low-risk applications.[15] In the short term, most firms will use AI as a 'co-pilot' to assist workers to make better decisions.

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[15] For example, the consequence of a poorly targeted email promotion to existing customers is low, while the consequence of an inaccurate diagnosis in healthcare is high.

Integrating AI to transform a firm's core business would typically lead to more significant changes in their productive processes compared to more passive uptake. As such there is scope for greater productivity gains as well as more cost and risk. The adjustment costs firms face in implementing AI may take longer to recoup for larger scale transformations – and hence slower and less certain productivity gains.

3. Policy levers supporting AI and productivity

There is already a wide range of Australian governments' technology policy interventions for AI (figure 2). However, five levers stand out as being more useful to support uptake of AI applications and innovations by the 98% of firms that are non-frontier:

• governments' role in building trust and trustworthiness
• governments leading by example in their use of AI
• reducing regulatory uncertainty (Paper 2, *The challenges of regulating AI*)
• building foundational capabilities to support AI uptake – especially human capital and digital connectivity
• setting appropriate access to data, including data collected and held by governments (Paper 3, *AI raises the stakes for data policy*).

Figure 2 – Examples of government programs to actively support Australian AI

Australian Government programs			
National AI Centre	The Responsible AI Network brings together a national community of practice to provide Australian businesses with best practice guidance, tools and learning modules	**AI Adopt program**	Program will establish 5 centres providing support for Australian small to medium enterprises (SMEs) to adopt AI technologies
Next Generation AI and Emerging Tech Graduates	Program provides scholarships to post-graduate students to study and work with industry partners and address skills shortages in AI and emerging technologies	**AI Opportunity in our Regions**	Program will provide up to 36 co-funded competitive grants to incentivise AI practitioners to engage with regional businesses to develop AI solutions for regional problems
State and territory government programs			
AI- or data-specific programs	• Data Analytics Centre (New South Wales) and AI Centre of Excellence (Victoria) • AI and data science innovation hubs (Queensland, Western Australia). Queensland's AI hub includes initiatives to grow AI talent and connect industry, government organisations and universities to local AI talent and technologies	**Broader tech policy initiatives**	• Innovation hubs (Victoria, South Australia) • Scaleup accelerator (Victoria) • Digital infrastructure and skills (Australian Capital Territory) • Digital business assistance (Tasmania) • Matched grant applications for small and medium sized business to adopt or develop innovative technologies (Victoria)

Sources: ACT Government (2020); DISR (2022); DISR (2023); Invest Victoria (2023); NSW Government (nd); Queensland Government (2018); Tasmanian Government (nd); WADSIH (nd).

Government's role in building trust and trustworthiness

Low levels of public trust and confidence of Australians in AI technologies and systems can pose a significant barrier to AI uptake (AIIA 2023, p. 18; DISR 2023, p. 3; Gillespie et al. 2023). Where consumers (or businesses) mistrust AI, they may avoid AI-related products and services.

Mistrust may reflect lack of knowledge by consumers and employees about AI-enabled products and services where risks are, in fact, low. This can be countered by digital literacy and upskilling programs on safe and appropriate use of AI.

Consumer mistrust can also be rational. Business may rush to adopt AI where they do not face the full costs when things go wrong. And consumers and AI-adopting businesses have available to them differing levels of information about the quality of AI products and services – including cyber security and proneness to discrimination or errors.

To some extent, markets will progressively reduce risks as suppliers of more reliable products establish their reputations and provide ongoing customer support. However, in markets with rapidly iterating or new products, or where AI customers are uncertain about the reliability of AI products, it may be desirable for market operation to have governments create consistent and reliable guidelines to enhance market information and confidence. Co-designed ethical and safety frameworks such as Australia's AI Ethics Principles, along with monitoring to establish the quality (or non-harm) of AI products and services can facilitate uptake.

The extent of government involvement needed may, however, be minimal where AI uses are covered by existing product safety rules, where industry has developed transparent and recognised codes or reputations to fix any problems, or where de facto international standards (say, due to US or EU laws) already exist. Some sectors may need industry-specific or more stringent regulatory requirements based on unique risks and potential harms. As one healthcare stakeholder noted, 'moving fast and breaking things' is not a good strategy in the healthcare sector (AAAIH nd, p. 2). Even within a single sector there may be a need for localised governance, accreditation or other forms of regulation for different AI use cases, such as different clinical settings within healthcare.

As many have noted, trust should not be sought as an end in itself – there is value in the public remaining 'appropriately sceptical' in order to take measures to protect their privacy and challenge illegal decisions (UNSW Reg Lab and UNSW Allens Hub 2023, p. 14). Trust must be founded on the proven *trustworthiness* of the product or service – and trustworthiness must be demonstrated through reliably mitigating risks and harms. Transparency and accountability are critical elements in building trust (Scopelliti 2023, p. 1).

Governments as exemplars

As a significant user of technology – and holder of data – government can have a large impact on innovation and deployment by AI providers, particularly through partnerships with the private sector. The Australian Tax Office's partnerships on Single Touch Payroll, for example, catalysed significant digital innovation (PC 2023c, p. 52).

Whether through buying off-the-shelf or through partnerships, governments can use their buying power to drive higher standards from AI suppliers or establish expectations of suppliers that other purchasers can then leverage (elevenM 2023, p. 10). Governments can, for example, include specific clauses in procurement contracts that require vendors to adhere to responsible AI practices, provide transparency, or undergo independent audits to ensure compliance (Scopelliti 2023, p. 41).

As noted by one government department, however, effectively managing AI-related procurements will require upskilling of government officials and close monitoring of procurements (Department of Health and Aged Care 2023, p. 5).

To the extent that governments can demonstrate safe and effective uses of AI in service delivery, including through pilots and trials, government use could encourage business adoption of AI solutions for similar use cases. Conversely, rushed adoption or misuse of technology[16] can undermine public confidence in automated decision making and AI.

The NSW Government has noted that policymakers can build public confidence and trust in emerging technologies through strong public governance and regulatory systems and by trialling and evaluating new technologies (NSW PC and NSW IPC 2022, p. 49). For example, the NSW Government's AI Assurance Framework aims to guide AI implementation in the public sector.

Governments must also ensure their use of AI does not lead to bias at scale. Public-facing agencies, in particular (such as law enforcement), should be careful to avoid systemic bias and harming the public interest.

Building public confidence in AI systems used by government depends on the perceived as well as actual integrity of AI systems – but recent research found that the community's awareness of AI protections and regulations applying to government use of AI was low (PM&C 2023, p. 28). Clearly defined and communicated regulatory frameworks are key to building trust and trustworthiness.

Regulatory certainty and clarity

Stakeholders have raised the need for a clear policy approach from government that addresses the need for regulatory certainty (Tech Council of Australia 2023, p. 8).

Business is also looking to government to clarify responsibility for AI harms under existing regulation. The Business Council of Australia noted:

> Guidance from Australian regulators is needed urgently. Without certainty in Australia, businesses across all sectors may delay investing in new technologies and innovations. This will place them at a disadvantage as their competitors overseas operating in environments with greater regulatory clarity are not faced with uncertainty. (BCA 2023, p. 9)

It is important to distinguish between uncertainty regarding *future* AI regulation, and the uncertainty that business expresses about how *existing* regulation applies or is implemented. Resolution of both sources of uncertainty is needed to support private sector investment in AI – but actions for government differ.

To achieve **regulatory clarity**, it is important that regulators provide guidance and advice on existing regulation. Effective enforcement (including test cases) can help clarify how regulations apply to AI.

Providing **regulatory certainty** for business on future regulation for a technology that is still rapidly evolving is a much harder task for governments. In many (and probably most) situations the most certain regulation is our *existing* set of laws together with a commitment that new regulations would only be introduced in discussion with all parties, *if and when* existing regulation was demonstrated to be inadequate. Including co-design with business and coordination across policymakers and regulators as design features of

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[16] Use of algorithmic decision making in the Robodebt scheme is a well-known failure by the Australian Government. The Robodebt scheme was designed to recover supposed overpayments from welfare recipients. The scheme did not produce accurate results, nor did it comply with the relevant legislation (Holmes 2023). Recent survey research found the Robodebt scheme undermined trust in public service agencies and continues to shape the community's views on public agencies as trustworthy adopters of AI (PM&C 2023, p. 16).

regulatory reform may provide additional confidence. As a general principle, technology-neutral regulation is likely to provide greater certainty and be less changeable than technology-specific regulation.

Competition and consumer laws provide an example of the ability of existing regulations to underpin increased regulatory certainty. The use of AI as a tool by businesses for misleading and deceptive conduct remains illegal, irrespective of the technology employed. New laws should only be considered where existing laws are not fit-for-purpose (Paper 3, *AI raises the stakes for data policy*).

In addition, good regulation is about more than achieving certainty – more certainty may need to trade-off some flexibility. **Regulatory consistency** (within Australia, and with global standards and regulations) is also an important goal. Paper 2, *The challenges of regulating AI*, considers what good regulation looks like in more detail.

Building digital literacy and expertise

Ensuring that there are adequate levels of digital literacy in the community would support both a more productive workforce and AI uptake. Having the skills to choose the most appropriate AI-enabled apps and use the apps to maximise productivity can go a long way to helping the majority of non-frontier firms successfully integrate AI into their operations.

Developing more specialised data and digital skills also assists AI uptake, but the private benefits associated with these training options means that many are already being taken up by Australian workers and businesses without the need for government involvement. A challenge for tertiary education institutions will be to keep up to date with technological developments and industry needs. As noted previously by the Commission, short courses and unaccredited training are often preferred by businesses for developing digital and data skills as they can be more relevant and up to date, as well as more flexible (PC 2023c, p. 71).

Business uptake of AI is also beginning to be supported by a nascent ecosystem of AI technology providers and AI support services in Australia, although support services tend to be provided in a siloed way, leaving businesses to shoulder the burden of creating integrated solutions (CSIRO 2023, pp. 12–13).[17] The Commission has not identified any barriers to the private sector providing such an ecosystem over time, provided digital and AI-specific skills continue to be invested in by businesses and individuals.

Skilled migrants often have knowledge of frontier technologies and practices and bring skills that are lacking in Australia. Measures to reduce bureaucratic hurdles to skilled migration – such as shifting away from overly restrictive and inflexible occupation lists for employer-sponsored temporary and permanent skilled migration (PC 2023a, p. 35) – could promote uptake of AI.

Investing in digital infrastructure

Modern AI requires access to vast amounts of computing power (compute). Cloud computing services are significantly positively associated with AI use, as is ultra-fast broadband connection for some countries (Calvino and Fontanelli 2023, pp. 40–43). These assets may be complementary to AI or to other factors enabling AI use. For example, cloud computing may be necessary to store and use large datasets that are needed for AI while ultra-fast broadband may be necessary for the use of cloud computing and data transfer. These dynamics create a hierarchy of technologies (figure 3).

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[17] For example, a retail and wholesale organisation adopted AI vision technology, but the provider was unable to integrate the AI-enabled components into the existing point-of-sale system (CSIRO 2023, p. 8).

Figure 3 – Firms adopt technologies hierarchically

Flow of US firms deploying different levels of technologies [a]
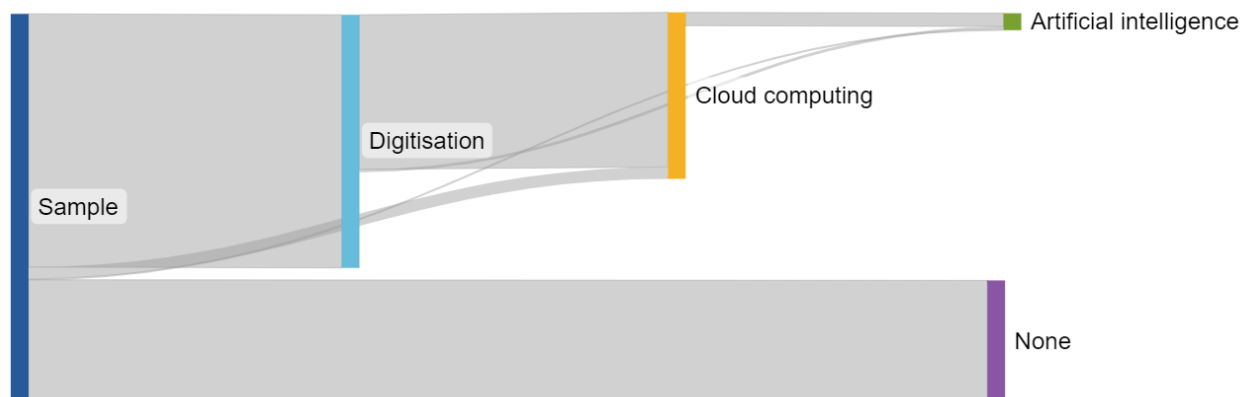
a. 'Sample' refers to all firms who responded to the 2018 US Census Bureau's Annual Business Survey.
Source: McElheran et al. (2023, p. 50).

Incentives for the private sector to supply compute to the market appear to be strong,[18] with scope for large providers to market their compute to consumers and derive benefits at scale.

Improving regional internet connectivity is, however, a way government can influence uptake of digital – and by extension AI-enabled – services for regional communities.[19]

Governments may need to invest in their own digital infrastructure to support data sharing, as well as address issues of digital maturity, fragmented and agency-centric technology capabilities and workforce gaps in data and digital skills (Australian Government 2023, pp. 12, 18, 19).[20]

Accessing quality data

AI systems, particularly machine learning models, rely on vast amounts of data to learn, adapt, and make accurate predictions. The quality and quantity of data fed into these systems directly influence their performance – and hence their contribution to productivity. One of the most effective ways governments could support the development and use of AI models in Australia is to establish clear and functional mechanisms for data collection, curation, sharing and use. Doing so will require policy and regulation to align multiple policy objectives, including economy-wide productivity, the rights of data holders, and commercial uses of data. And while this balance is nothing new, AI has heightened some risks around personal data (including those related to privacy, discrimination and consumer protections) and raised the stakes regarding commercial data (including issues around copyright).

The most immediate way governments can contribute to this objective is to curate and safely share their own data. The Government's interim data and digital strategy notes that the Australian Public Service manages a

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[18] Microsoft's recently announced investment in public cloud services in Australia provides evidence of the strong commercial incentives to provide public cloud (Smith 2023).

[19] The Commission has previously argued for more transparency around digital infrastructure funding decisions and evaluation of previous investments (PC 2023b).

[20] The interim *Data and Digital Government Strategy* noted that the Australian Government's data and digital ecosystem is constrained by bespoke and outdated systems that introduce risk and impact data quality, process and integration (Australian Government 2023, p. 9).

vast amount of data that is not used to its full extent, and access remains restricted despite the clear benefits derived from safely sharing data across public and private sectors (Australian Government 2023, p. 9). One area where there is opportunity to get more value from data is health, including My Health Record. Aged care, education, and childcare sectors may also provide opportunities for safely sharing data collected by providers of government-funded services.

Issues around data access are discussed further in Paper 3, *AI raises the stakes for data policy*.

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