Horizon Scanning Series

The Effective and Ethical Development of Artificial Intelligence: An Opportunity to Improve Our Wellbeing

Economic and Social Inequality

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AI and Inequality in Australia

The rise of Artificial Intelligence (AI) has enthralled the public. The torrent of bold predictions engender both hopes of productivity and fears of obsolescence. Among the primary concerns with AI are that of rising inequality.[1]

The World Economic Forum identified income and wealth inequality as the biggest global risk.[2] While technological progress is one of several factors that affect inequality,[3] the rapid developments of AI rightfully raise questions whether the benefits will be equitably distributed. Democracies depend on the benefits of growth to be reasonably shared to ensure social cohesion and equality of opportunity. This is just as relevant for Australia as it is for all national economies.

Current state of inequality in Australia

The state of economic inequality in Australia is complicated and subject to interpretation. This reflects the complexities of inequality measurement and evaluation. From a national average perspective, income and wealth inequality have remained relatively constant over the past few decades.[4] There was a general trend of increased income inequality until the Global Financial Crisis, which has stabilised since. According to the Gini coefficient, a common measure for income inequality, Australia's income inequality ranks slightly above average compared to other advanced OECD economies.[5]

Beneath the averages, however, are signs of rising economic inequality. For instance, the top 1% and 10% of income earners have commanded consistently higher shares of national income in Australia since 1980.[6] This is also in the context of increasing wage growth for

[1] Inequality broadly refers to unequal outcomes, rights, or opportunities. Economic inequality concerns the unequal distribution of economic resources between, and within, groups of individuals, firms, industries, and economies. Social inequality refers to the unequal distribution of resources and opportunities through norms of allocation that engender specific patterns of socially defined categories, such as race, gender, or sexual orientation. This paper focuses on the implications of AI on economic and social inequalities in Australia.

[2] World Economic Forum. 2017. "The Global Risks Report 2017", Geneva: World Economic Forum. http://wef.ch/risks2017

[3] Other significant factors include: economic performance; labour conditions and employment growth; education and training programmes; minimum wage policies; taxation and redistribution policies; and trade and globalisation.

[4] Australian Bureau of Statistics. 2017. "6523.0 - Household Income and Wealth, Australia, 2015-16". accessed via: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/6523.0~2015-16~Main%20Features~Household%20Income%20and%20Wealth%20Distribution~6; *and* Wilkins, R. 2017. "The Household, Income and Labour Dynamics in Australia Survey: Selected Findings from Waves 1 to 15." Melbourne Institute. Accessed via: http://melbourneinstitute.unimelb.edu.au/__data/assets/pdf_file/0010/2437426/HILDA-SR-med-res.pdf

[5] OECD. 2018. "Income Inequality". Accessed August 8, 2018. https://data.oecd.org/inequality/income-inequality.htm "*The Gini coefficient is based on the comparison of cumulative proportions of the population against cumulative proportions of income they receive, and it ranges between 0 in the case of perfect equality and 1 in the case of perfect inequality.*"

[6] World Inequality Database. 2018. "World Inequality Database - Australia." Accessed August 8, 2018. https://wid.world/country/australia/.

higher earners, with higher levels of education, compared to middle and lower-income earners, with lower levels of education.[7]

Layering these changes on top of entrenched disadvantage adds to the complexity. A sizeable part of Australia's population remains left behind, with 13 percent of Australians from 0-17 years below the poverty line.[8] These levels of inequality are more likely to affect particular groups of the population, such as Indigenous Australians and people with a disability. The location of where a child grows up also has a causal effect on their adult income outcomes in Australia, favouring urban dwellers.[9] Regardless of whether one interprets inequality in Australia to be a huge issue, it is subject to change. If the 'promise of AI' fulfils its projected economic impacts, then it will certainly have profound structural effects on the Australian economy. How these economic benefits are distributed will influence economic and social inequality outcomes.

Relationship between technology and economic inequality

The historical relationship between transformational technologies and inequality depends on the length of time examined. The broad sweep of technological progress has improved inequality by lifting productivity, expanding the demand for labour, and increasing income, wealth, and quality of life.[10] This progress, however, was not immediate and often required more than 50 years for economies to adjust and widely diffuse its applications.[11] Therefore, the short-run disruptions of transformational technologies have caused profound structural changes to labour markets and economic activity. These initial decades have typically required significant labour transitions and have contributed to widening short-run inequalities.[12]

In comparison to other General Purpose Technologies (GPTs), such as electricity and personal computers, the impacts of AI are likely to be a continuation of this 'short term pain for long-term gain' trend. That is, the adoption and diffusion of new technologies expand markets which affects the supply, demand, and mobility of resources and labour.[13] These new technologies improve productivity for industries, populations, and individuals to varying extents. This skews the distribution of benefits to those with the skills to make productive use of the new technologies.[14] As a result, wage premiums are earned by those with the skills that

[7] OECD. 2017. "Education at a Glance 2017". Paris: Organization for Economic Cooperation and Development. Accessed via: http://www.oecd-ilibrary.org/education/education-at-a-glance-2017_eag-2017-en

[8] OECD. 2018. "Poverty Rate". doi:10.1787/459aa7f1-en

[9] Deutscher, Nathan. 2018. "Place, Jobs, Peers and the Importance of the Teenage Years: Exposure Effects and Intergenerational Mobility." https://nathandeutscher.com/research/.

[10] Mokyr, Joel, Chris Vickers, and Nicolas L. Ziebarth. 2015. "The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different?" *The Journal of Economic Perspectives: A Journal of the American Economic Association* 29 (3): 31–50.

[11] Jovanovic, Boyan, and Peter L. Rousseau. 2005. "General Purpose Technologies." Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w11093. pg. 3-5.

[12] Bruckner, Matthias., Marcelo LaFleur, and Ingo Pitterle. 2017. "The Impact of the Technological Revolution on Labour Markets and Income Distribution." United Nations. https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/2017_Aug_Frontier-Issues-1.pdf.

[13] Davis, Nicholas. 2018. "The Future Relationship between Technology and Inequality." *How Unequal? Insights on Inequality*, Committee for Economic Development of Australia. pg. 113.

[14] Milanovic, Branko. 2016. *Global Inequality: A New Approach for the Age of Globalization*. Harvard University Press.

complement these technological changes, which can cause or exacerbate economic inequality. Additionally, as the share of income shifts from labour to capital, tax collection also becomes more difficult for governments, which can strain public revenues.[15] This process of 'creative destruction' by technological progress has been a relative constant in history of human innovation since the Agricultural Revolution.[16] In the long-run, people adapt, the overall demand for labour is reinforced, and inequality lessens.

Why then should we be concerned with the risks of AI increasing economic inequality?

Risks of AI to economic inequality

AI represents a potential departure from other GPTs due to the scope of capabilities, the speed of development, and the scale of impact. Building upon the technological transformations of information technologies and digital communications, AI is performing non-routine tasks that would otherwise require human cognition. Technological automation has traditionally occurred in areas of routine and manual labour because these tasks are relatively simple to codify. AI expands the scope automation to include cognitive and non-routine tasks. Machine Learning systems are being applied to trade on financial markets, diagnose disease, and identify weather patterns. Tasks that have previously required human intelligence are being performed by AI applications at large scales and lightning speeds.

The multi-use capabilities of AI techniques have developed at an almost breakneck pace over the past two decades, and development continues to accelerate.[17] This positions the economic impact of AI to be one of the most significant in the history of GPTs.[18] Therefore, the implications of AI on inequality should be examined according to the degree of structural changes in the Australian economy. Among the most important is the impact that AI will have on labour demand.

AI, automation, and labour

The rise of AI has led to cries of widespread labour automation from all corners of industry. Predictions have varied from 9 to 47 percent of current occupations in advanced economies, like Australia.[19] This has led to headline grabbing claims of technological unemployment and human obsolescence. Yet, occupations consist of many tasks that are difficult to automate.[20]

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[15] Abbott, Ryan, and Bret Bogenschneider. 2017. "Should Robots Pay Taxes? Tax Policy in the Age of Automation." *Harvard Law and Policy Review* 12 (1): 145–75.

[16] Schumpeter, J. 1942. Capitalism, Socialism, and Democracy. New York: Harper & Bros.

[17] Shoham, Yoav, Raymond Perrault, Erik Brynjolfsson, and Jack Clark. 2017. "AI Index." Stanford University. Accessed via: https://aiindex.org/2017-report.pdf.

[18] *See, for example*: Brynjolfsson, Erik, and Andrew McAfee. 2016. *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. 1 edition. W. W. Norton & Company.

[19] Arntz, Melanie, Terry Gregory, and Ulrich Zierahn. 2016. "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis." *OECD Social, Employment, and Migration Working Papers; Paris*. United States--US, France, Paris: Organisation for Economic Cooperation and Development (OECD). https://doi.org/10.1 787/5IIz9h56dvci7-en; *and* Frey, Carl Benedikt, and Michael A. Osborne. 2017. "The Future of Employment: How Susceptible Are Jobs to Computerisation?" *Technological Forecasting and Social Change* 114 (January): 254–80.

[20] McKinsey Global Institute. 2017. "Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation." McKinsey & Co. https://www.mckinsey.com/~/media/McKinsey/Global%20Themes/Future%20of%20Organizations/What%20the%20future%20of%20work%20will%20mean%20for%20jobs%20skills%20and%20wages/MGI-Jobs-Lost-Jobs-Gained-Report-December-6-2017.ashx.

In addition, these headline predictions neglect the new tasks and occupations that will arise courtesy of AI. While AI-enabled automation is expected to have a significant impact on the Australian economy, this must be balanced with the economic and social benefits that AI will provide.

The focus, therefore, shouldn't centre on whether AI will destroy jobs; societies have regularly adapted to industrial and labour transformations from previous GPTs.[21] Rather, the focus should reorient towards the types of new skills and jobs demanded by AI, how to equip people with these skills, and the implications on inequality if the Australian labour market is slow, or fails, to transition to meet these new economic demands.

Growing skills divide

Risks to inequality arise when the 'race between education and technology' heavily favours technology.[22] That is, the rate of technological change outpaces the speed at which people can develop the new skills demanded by technology. Inequalities of wages then emerge as the demand for labour skills that complement new technologies increase and attract a wage premium. For example, skills that are non-routine and cognitive, such as abstract thinking in Machine Learning development, benefit from advances in AI due to strong complementarities between routine and cognitive tasks.[23] This raises the productivity and demand for workers with complementary skills to technology, thus driving up their wages.

The problem is that these skills, and subsequent wage premiums, disproportionately favour the highly educated. Australians with a bachelor degree in 2015 earned, on average, a 40 percent wage premium compared to someone with a high school diploma. A master's degree or doctorate earned a 79 percent premium.[24] And since 2001, these premiums are up from 20 percent and 55 percent, respectively.[25] There are risks that the growth of AI will further exacerbate this trend.

This is problematic for inequality because jobs demanded by AI will likely require higher levels of skills and different mindsets, which could be difficult, or impossible, to develop for many workers. For instance, 36% of all jobs across all industries will require complex problem-solving skills by 2020, compared to 4% of jobs where basic physical abilities are a core requirement.[26] Additionally, demand for advanced IT and programming skills could grow as much as 90% by 2030, whereas basic data input and processing skills could experience a

[21] *See, for example*: Bresnahan, Timothy F., and Manuel Trajtenberg. 1995. "General Purpose Technologies 'Engines of Growth'?" *Journal of Econometrics* 65 (1): 83–108.
[22] Goldin, Claudia Dale, and Lawrence F. Katz. 2009. *The Race between Education and Technology*. Harvard University Press.
[23] Autor, David H. 2015. "Why Are There Still So Many Jobs? The History and Future of Workplace Automation." *The Journal of Economic Perspectives: A Journal of the American Economic Association* 29 (3): 3–30.
[24] OECD. 2017. "Education at a Glance 2017". Paris: Organization for Economic Cooperation and Development. Accessed via: http://www.oecd-ilibrary.org/education/education-at-a-glance-2017_eag-2017-en
[25] OECD. 2003. "Education at a Glance 2003". Paris: Organization for Economic Cooperation and Development. Accessed via: http://www. oecd.org/site/worldforum/33703760.pdf
[26] Schwab, Klaus, and Richard Samans. 2016. "The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution." World Economic Forum. pg. 21-22. http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf.

decline of 23% over the same period.[27] These skills require higher levels of education and training, and AI will likely account for a significant proportion of these dynamics.[28]

AI technologies are also more likely to replace, rather than augment, routine tasks. Such tasks are disproportionately found in low to middle-skilled occupations with lower levels of education.[29] Therefore, these low and middle-skilled jobs, which are already missing out on the wage premium, are also more exposed to AI-enabled labour automation and shifts in skill demands.[30]

Employment polarisation

Skill shortages result in unfavourable economic and social outcomes. If only a small and shrinking proportion of the labour market can fulfil these high-skilled jobs, it places downward pressure on everyone else. More people enter the pools of lower skilled work and wages decrease as more people slide down the skill curve. Meanwhile, wages in higher-skilled labour disproportionately rise.

The effect of growing displacement of low and medium-skilled labour is referred to as 'employment polarisation'. This is where labour supply becomes concentrated at either ends of the skill spectrum, which can obstruct upward social mobility.[31] If employment polarisation worsens, there are fewer opportunities for people to climb the skill ladder, as the middle-skilled rung is weakened or shifted.

This process of turnover, accelerated by AI-enabled automation, could lead to sustained periods of underemployment or unemployment. Not all workers will have the training, skills, or safety-nets to successfully transition into the new jobs created by AI. It can also result in the widening of income inequality. As income from wages represents the majority of income for most households, and this dependence on wage income increases for poorer households,[32] then widespread labour automation threatens economic security. Unless managed well, the transition effects of labour displacement caused by AI could have serious implications on economic inequality, and reinforce existing inequalities in Australia.

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[27] Bughin, Jacques, Eric Hazan, Susan Lund, Peter Dahlström, Anna Wiesinger, and Amresh Subramaniam. 2018. "Skill Shift: Automation and the Future of the Workforce." McKinsey Global Institute. pg. 7. https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Future%20of%20Organizations/Skill%20shift%20Automation%20and%20the%20future%20of%20the%20workforce/MGI-Skill-Shift-Automation-and-future-of-the-workforce-May-2018.ashx.

[28] Brynjolfsson, Erik, Daniel Rock, and Chad Syverson. 2018. "Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics." In The Economics of Artificial Intelligence: An Agenda. University of Chicago Press.

[29] Frey, Carl Benedikt, and Michael A. Osborne. 2017. "The Future of Employment: How Susceptible Are Jobs to Computerisation?" *Technological Forecasting and Social Change* 114 (January): 254–80.

[30] Bakhshi, H., Downing, J., Osborne, M. and Schneider, P. 2017. *The Future of Skills: Employment in 2030*. London: Pearson and Nesta.

[31] Santos, Indhira. 2016. Labor market polarization in developing countries: challenges ahead [Blog], World Bank Group.

[32] Piketty, Thomas, and Arthur Goldhammer. 2014. Capital in the Twenty-First Century. Harvard University Press. pg. 382-423.

Social implications of rising inequality

If economic inequality were to acutely rise due to the effects of AI, then not only could the growth of AI be inhibited, but also the risks of social fragmentation could increase. In scenarios where workers are displaced by AI, and they do not receive adequate transition support or subsistence compensation, those affected could rationally oppose AI developments.[33] If a large part of the population do not economically benefit from the growth of AI, it is rational that they would defend their economic position. This rejection of modernity could compromise social and economic development. As a result, AI is less likely to adopted and diffused throughout the economy, which hampers economic growth, and also fuels political discontent because its benefits are being inequitably distributed. This is not a recipe for peace and democratic order. Rising inequality threatens social stability, which is highlighted by the positive correlation between income inequality and crime rates, both within and between countries.[34]

The Australian workers who are more likely to be adversely affected by AI are also more likely to experience current levels of inequality, due to lower levels of education. It is therefore critical for the benefits of AI to be distributed equitably. Unless this is achieved, AI threatens to perpetuate these entrenched disadvantages, which is harmful to Australia economically and socially.

Mitigating the rise of inequality

Public institutions play a central role in determining market structures that affect economic distribution. This role is difficult, demanding a precarious balance between encouraging innovation on one hand, and ensuring its benefits are shared equitably on the other. In the context of AI and inequality, policymakers have a range of mechanisms they can call upon, such as:

- *Taxation and redistribution*: Applying effective tax and redistribution systems to ensure that the surpluses earned by innovators and investors help to support those inadvertently impacted by AI. This is typically performed through progressive taxation and transfers, which provides workers with subsistence compensation during periods of employment transition.
- *Infrastructure*: Effective digital infrastructures that help to diffuse AI equitably, such as 5G mobile networks and standards that foster open-data sharing. Infrastructures, such as Internet connectivity and access to digital devices, provide the backbone for the diffusion of AI. In a country as large and dispersed as Australia, ensuring equitable access to these critical infrastructures affects the extent of benefits that AI provides, particularly for rural and remote populations.
- *Antitrust policies*: Regulating anti-competitive behaviours by ensuring that companies do not stifle market competition and exhibit rent-seeking behaviours that adversely affect innovation and the consumer.

[33] Korinek, Anton, and Joseph E. Stiglitz. 2017. “Artificial Intelligence and Its Implications for Income Distribution and Unemployment.” *NBER WORKING PAPER SERIES*, December, 44. pg. 3.

[34] Fajnzylber, Pablo; Daniel Lederman; and Norman Loayza. 2002. “Inequality and Violent Crime.” The Journal of Law and Economics 45 (1): 1–39.

- *Intellectual property rights*: Creating incentives for companies to innovate by granting patents, but also ensuring that these exclusive rights do not unfairly block barriers to market entry.
- *Education and training*: Investing in the development of high-demand skills for youth, such as Science, Technology, Engineering, and Mathematics, and targeted worker transition programs to assist people whose jobs have been displaced by AI.
- *Minimum wage*: Helping to ensure that no one who works full time is in poverty.
- *Public research*: In parallel with effective antitrust policies, public research can help reduce the scope for monopolies that capture large portions of innovation returns. Innovations that are funded by public expenditure can be owned by the State and achieve market returns that contribute to public revenue, such as the CSIRO WiFi patent.[35]

AI offers a breadth and depth of opportunities rarely seen in the history of human innovation. While the developments of AI must be nurtured to help realise its potential, it should not be done by creating a dangerously unequal society. Public policies play a critical role for ensuring that the benefits of AI are not unreasonably concentrated and reinforce existing inequalities.

While there is an air of inevitability about AI, it is important to remember that technology is never deterministic. Future directions are fundamentally rooted in human judgement.

So, in a world of omnipresent AI, the progress of society is neither guaranteed nor hopeless. Instead, it is up to us.

[35] CSIRO. 2015. “Our Top 10 Inventions.” CSIRO. March 17, 2015. https://www.csiro.au/en/About/History-achievements/Top-10-inventions.