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by Tahsin Mehdi and Marc Frenette

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Exposure to artificial intelligence in Canadian jobs: Experimental estimates

by Tahsin Mehdi and Marc Frenette

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Recent developments in artificial intelligence (AI) have raised questions about the future of work. Debates centre primarily around the possibility of AI displacing some human workers. Predicting the effects of technological transformation on the labour market is challenging. This is especially true for AI given the uncertainty surrounding the breadth of its potential; the pace of its development and implementation; and how workers, businesses and governments might react and adapt.

Past studies on technological transformation examined the potential impact of automation on the Canadian labour market (Frenette and Frank, 2020). Automation is generally understood to be the use of machines to perform simple, routine and non-cognitive tasks. AI, on the other hand, can perform complex, non-routine and cognitive tasks. AI's capabilities are growing, and it is unclear how powerful it may be in the future.

While it is difficult to predict the net impact of AI on jobs in Canada, Mehdi and Morissette (2024)—integrating data from the 2016 and 2021 censuses of population with data from the Occupational Information Network—offer some experimental estimates of occupational exposure to AI using the methodology developed by Felten, Raj and Seamans (2021) and Pizzinelli et al. (2023). The measure used is the complementarity-adjusted AI occupational exposure index, which can classify jobs into three AI groups using the median AI occupational exposure index and complementarity scores: (1) high exposure and low complementarity, (2) high exposure and high complementarity, and (3) low exposure (regardless of the degree of complementarity). The first two groups consist of jobs that may be highly exposed to AI, but the first group may have relatively more tasks that could be replaced by AI in the future, while the second group may have relatively more tasks that are highly complementary with AI. The third group of jobs are those that may be less exposed to AI than the first two groups, regardless of the degree of complementarity.

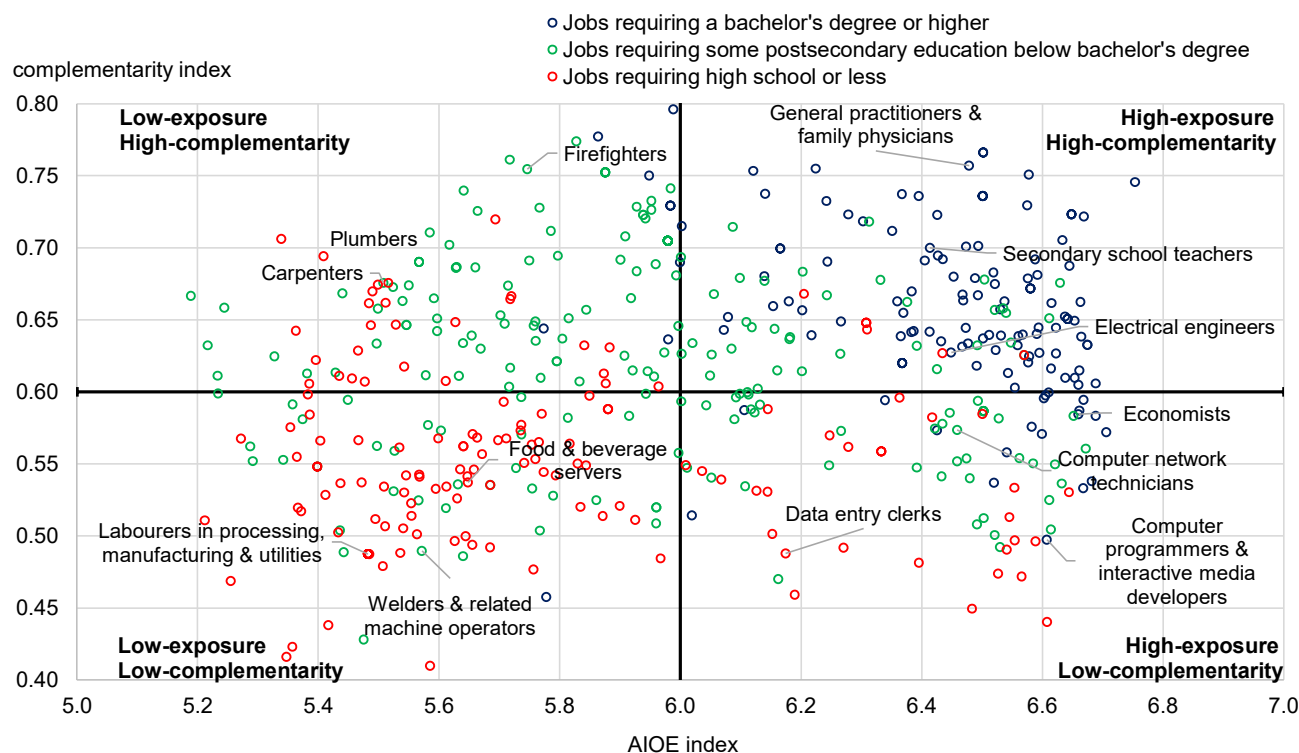
Employers may not immediately replace human labour with AI, even if it is technologically feasible to do so, because of financial, legal and institutional constraints. Consequently, exposure to AI does not necessarily imply a risk of job loss. At the very least, it could imply a certain degree of job transformation. Given the uncertainty surrounding AI, the experimental estimates presented here should be interpreted with caution. Only time will tell how the impact of AI will unfold.

The majority of workers in Canada are in jobs that may be highly exposed to job transformation related to artificial intelligence, but about half of them could benefit from it

In May 2021, 31% of employees aged 18 to 64 in Canada were in jobs that may be highly exposed to AI and relatively less complementary with it, 29% were in jobs that may be highly exposed to and highly complementary with AI, and 40% were in jobs that may not be highly exposed to AI. These findings were largely unchanged compared with those of May 2016 and are consistent with international evidence from other advanced economies, such as the United States (Cazzaniga et al., 2024)

Figure 1 illustrates the potential for AI to transform a broad set of occupations, regardless of skill level. Jobs that could be highly exposed to AI-related job transformation are generally those that require higher education. Despite this, professions such as doctors, nurses, teachers and electrical engineers may be highly complementary with AI technologies.¹ In contrast, professions such as those in business, finance, and information and communications technologies—which may also require higher education—have less potential complementarity with AI. However, this does not necessarily mean that these jobs will be in less demand in the future because of AI, as many of them are critical to the economy. Instead, AI could play a transformational role, leading to the creation of new tasks within these jobs, or to new jobs entirely.

Figure 1
Potential artificial intelligence occupational exposure (AIOE) and complementarity in Canada



Notes: The AIOE index and potential complementarity are based on Felten, Raj and Seamans (2021) and Pizzinelli et al. (2023). An occupation is considered high-exposure if its AIOE index exceeds the median AIOE across all occupations (6.0) and considered low-exposure otherwise. Similarly, an occupation is considered high-complementarity if its complementarity parameter exceeds the median complementarity across all occupations (0.6) and considered low-complementarity otherwise. Occupations in this chart are based on the 4-digit National Occupational Classification (NOC) 2016 version 1.3 converted from the United States Standard Occupational Classification (SOC) 2018. Of the 500 NOC occupations, 10 occupations which represented less than 1% of Canadian employment, were excluded due to a lack of Occupational Information Network (O*NET) data for computing the AIOE or complementarity parameter.

Source: Occupational Information Network (O*NET) version 28.2.

Certain groups of workers, such as those living in urban areas, women, higher earners and highly educated individuals, are more likely to be employed in jobs that could be highly exposed to AI-related job transformation than other groups. However, they are also more likely to be employed in jobs that could be highly complementary with AI. The AI exposure differences among these groups of workers are largely driven by differences in the mix of occupations they hold. The ability to adapt to technological changes could also vary across individuals.

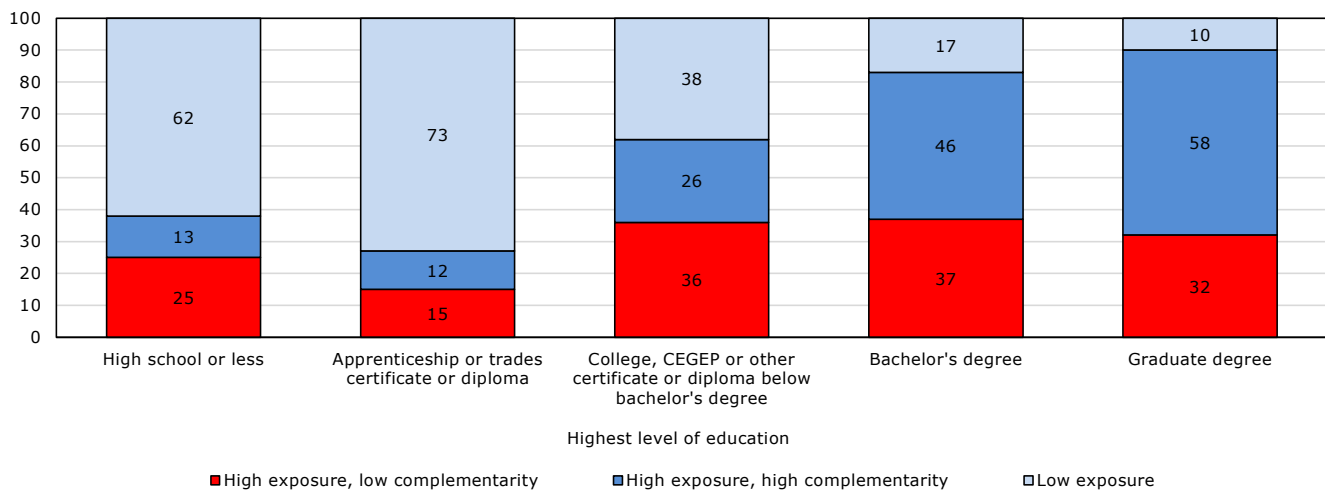
1. Jobs that could be highly complementary with AI are those that may be relatively less conducive to the unsupervised use of AI. For example, medical professions can use AI to help diagnose diseases and monitor patients, but these jobs carry a high burden of responsibility for others, so the criticality of decisions and the grave consequences of potential errors may require human workers in these jobs to make final judgments. These are just some of the aspects to consider when assessing the degree to which jobs can be complementary with AI. See Mehdi and Morissette (2024) for other aspects of complementarity.

Highly educated workers are more likely than their less educated counterparts to be in jobs that are highly exposed to job transformation related to artificial intelligence

While previous waves of technological transformation primarily affected less educated workers, AI may be more likely to affect more highly educated workers, because these workers are more likely to be in jobs that tend to have cognitive-oriented tasks. Chart 1 shows that 83% to 90% of workers with a bachelor’s degree or higher were in jobs that could be highly exposed to AI-related job transformation. However, more than half of these highly educated workers are in jobs that may be highly complementary with AI. Workers whose highest level of education was an apprenticeship or a trades certificate were the least likely to be in jobs that may be highly exposed to AI-related job transformation (27%). These workers are more likely to be employed in the skilled trades, which may be relatively less exposed to AI-related job transformation.

Chart 1
Potential artificial intelligence occupational exposure and complementarity across education levels in Canada, May 2021

percentage of employees



Notes: The sample consists of employees aged 18 to 64 living off reserve in private dwellings, excluding full-time members of the Canadian Armed Forces. The artificial intelligence occupational exposure index and potential complementarity are computed using Occupational Information Network data and are based on Felten, Raj and Seamans (2021) and Pizzinelli et al. (2023).

Sources: Statistics Canada, Census of Population, 2021; and Occupational Information Network version 28.2.

Conclusion

Recent advances in AI have fuelled excitement, as well as concerns, regarding its implications for the economy and beyond. While previous waves of technological transformation raised concerns regarding the future of jobs involving routine and manual tasks, a broader segment of the labour force could be affected in an era when AI is increasingly becoming capable of performing non-routine and cognitive tasks typically done by highly skilled workers.

It is unclear what the net impact of AI will be on jobs in Canada. Experimental estimates of occupational exposure to AI suggest that higher-skilled jobs may be more exposed to AI-related job transformation than lower-skilled jobs. But half of the workers in jobs highly exposed to AI-related transformation may also benefit from it, as long as AI complements the work they do and, when required, they have the necessary skills to leverage it.

The experimental estimates presented here are meant to be forward-looking based on the current state of AI. They do not account for economic dynamics such as the long-term adaptability of workers, businesses and governments. Moreover, the estimates are based on a subset of current AI applications and capture only a narrow view of AI (i.e., generative AI, or AI that responds passively to requests). They exclude more general forms of AI that may be integrated with robotics hardware and have advanced capabilities to think and act autonomously. As AI's capabilities grow over time, the applicability of the method used in this study could decrease.

The results from this study can inform labour market policies related to reskilling and career planning, but it should be noted that wide-scale implementation of new technologies can take time. There is also uncertainty surrounding the scale of AI adoption by businesses. Even if AI were to have no net impact on jobs, it may still have implications for other facets of the economy, such as labour productivity and income inequality. How workers, businesses and governments respond and adapt to the potentially evolving developments and implementation of AI remains to be seen.

Authors

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