

# Study: The Employment Consequences of Robots: Firm-level Evidence

*Released at 8:30 a.m. Eastern time in The Daily, Monday, November 2, 2020*

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Firms that invested in robots from 1996 to 2017 employ more, not fewer, workers. That is the overall conclusion of new studies released today, titled "The Employment Consequences of Robots: Firm-level Evidence" and "The Effect of Robots on Firm Performance and Employment." The studies found that firms expanded both their high- and low-skilled workforce, although not their middle-skilled workforce after investing in robots. Firms also use fewer managers when robots arrive.

Recent improvements in robotics have rekindled concerns about their impact on humanity. A major concern is that they will displace human workers who perform routine tasks from the economy. Understanding the impact robots will have on different workers requires an understanding of what firms are adopting them and why. Do firms adopt robotics to improve business performance in competitive markets, or simply to reduce prices by cutting labour costs? To answer these questions, a new firm-level database on robot investment, described in the paper "How to Build a Robots! Database," was developed from administrative data sources. The new data were linked to existing firm-level data on employment and performance, and to the Workplace and Employee Survey (WES) covering worker characteristics (e.g., education and training), workplace conditions and firm strategies.

The robot investment data show that, since 2008, investment in industrial robots has continued to increase while investment in robots devoted to automotive assembly lines has tailed off. In 2008, the stock of robots was \$1.2 billion, just under half of which was for automotive assembly lines. By 2017, less than \$400 million of the \$1.5 billion in total robot stock was in the automotive sector. Increasingly, enterprises in agriculture, mining, construction, as well as service sectors like health, and waste management have invested in robots over this period.

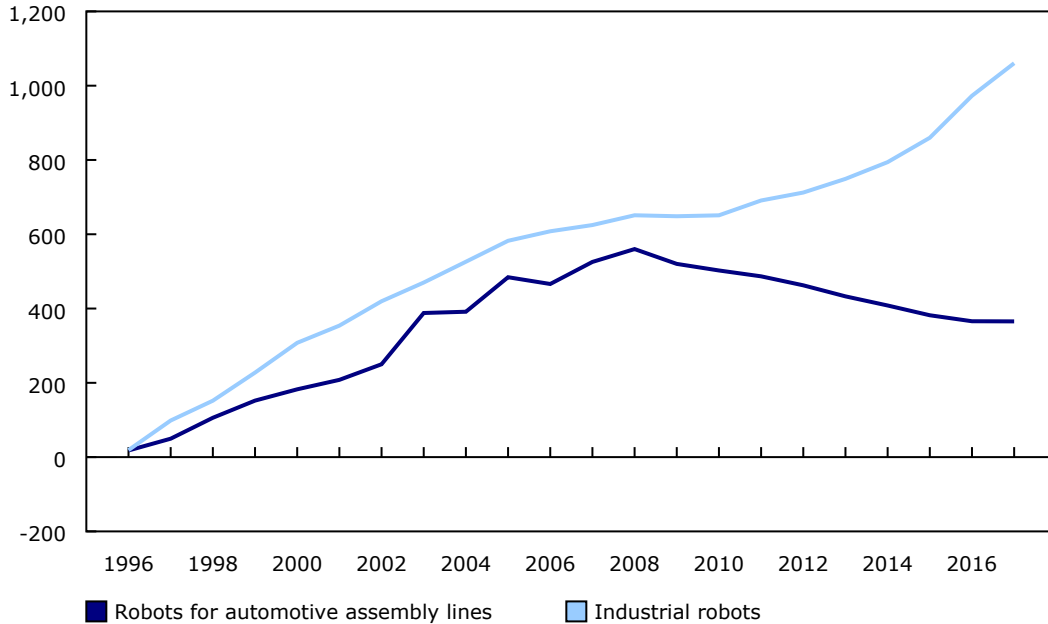
Analysis of the microdata underlying these aggregates shows that robot adoption generally has a positive impact on employment in individual firms but the impact differs across workers with different skills. Firms had 15% higher employment relative to their industry's average performance after adopting robots. Relative increases in employment were found for firms in individual industries after accounting for size, unionization, outsourcing, and other firm-specific characteristics.

However, a detailed examination of robot-adopting firms found in the WES shows that employment expanded in the high skilled (in jobs requiring a university degree) and low skilled (high school or less) categories. Robot-adopting firms' middle-skilled workers (in jobs requiring vocational or trades accreditation) were more likely to leave and not be replaced after robots arrived.



**Chart 1**  
**Robot stock, industrial robots and robots for automotive assembly lines**

millions of dollars



**Note(s):** Robot stocks calculated based on 12-year useful life suggested by the International Federation of Robotics.  
**Source(s):** Statistics Canada, import data.

Evidence from the WES also shows that robot adopters use fewer managers than their non-robot-adopting counterparts, after taking into account other differences between firms. One possible explanation is that robots can repeat multiple tasks with a precision and consistency that humans cannot, and greater consistency may mean firms need fewer managers to monitor workers to ensure quality. Moreover, the evidence from the WES shows that in place of managerial oversight, workers are given greater decision-making authority and individual performance incentives. But their work with or alongside robots becomes less routine, and they are forced to be more flexible.

These studies also show that robots allow firms to increase productivity. Investments in robots increased firm output by 0.8% per year on average, after accounting for the differences in use of other inputs, industry, geography, and the business cycle. Examining the WES questions on firm strategy reveals that robots are associated with firms focussing more on increasing product and service quality, and not on reducing labour costs.

These results suggest that robots will lead to better firm performance by improving the quality of products and services rather than simply reducing labour costs. Robots will also bring disruption to jobs, not only displacing some jobs, but also changing the requirements of other jobs. Not all workers will benefit from this change.

**Note to readers**

*The paper "How to Build a Robots! Database" describes the creation of firm-level panel data on robot adoption created from Canadian import data. Most robotics hardware deployed by Canadian firms is produced abroad by major global robotics firms. They are identified as robots for customs purposes when they cross the border.*

The research studies "[The Employment Consequences of Robots: Firm-level Evidence](#)," "[The Effect of Robots on Firm Performance and Employment](#)," and "[How to Build a Robots! Database](#)" are now available.

Also released today is an infographic titled, "A glance at robots in the Canadian economy, 1996 to 2017," available as part of the series *Statistics Canada – Infographics* ([11-627-M](#)).

Also of interest and released today is a research article titled "[Canadians' Views on Automation and Net Job Creation in 1989: Were They Right?](#)," which is part of the *Economic Insights* series (11-626-X).

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To enquire about "The Employment Consequences of Robots: Firm-level Evidence," "The Effect of Robots on Firm Performance and Employment," or "How to Build a Robots! Database" contact Jay Dixon ([jay.dixon@canada.ca](mailto:jay.dixon@canada.ca)), Economic Analysis Division.

To enquire about "Canadian's Views on Automation and Net Job Creation in 1989: Were they Right?," contact René Morissette ([rene.morissette@canada.ca](mailto:rene.morissette@canada.ca)), Social Analysis and Modelling Division.