Robots replace routine tasks performed by workers

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Rapid improvements in robot capabilities have fuelled concerns about the implications for jobs. This column examines the effect robots have had on jobs in industries across high-income and emerging countries from 2005 to 2015. The rise in robot adoption relates to a fall in the employment share of occupations that are intensive in routine tasks. This relation is observed in high-income countries, but not in emerging market and transition economies.

If anything, the Covid-19 pandemic has made many of us realise that automation is going to become a greater part of our work. The main drivers of automation used to be efficiency and productivity, but health and safety concerns have now been added to that list. Yet, rapid improvements in the capabilities of robots could also result in the replacement of workers in a widening range of tasks. That has triggered widespread concerns about potential impacts on jobs (Acemoğlu and Restrepo 2018, Dauth et al. 2019). The possible acceleration of automation due to Covid-19 has put further impetus to this debate (Seric and Winkler 2020).

In a recent paper, Graetz and Michaels (2018) find that robots contribute to productivity growth across industries in high-income countries. But robot adoption does not reduce employment. If robots have no impact on the overall level of employment, the question is whether they affect employment in other ways (e.g. Marin 2014, Faia et al. 2020). Data limitations did not allow Graetz and Michaels (2018) to examine the impact of robots on workers that perform different tasks. In a new paper (de Vries et al. 2020), we empirically study the impact of industrial robots on the occupational structure of the workforce across manufacturing industries in a set of high-income as well as emerging economies.

A task perspective on production

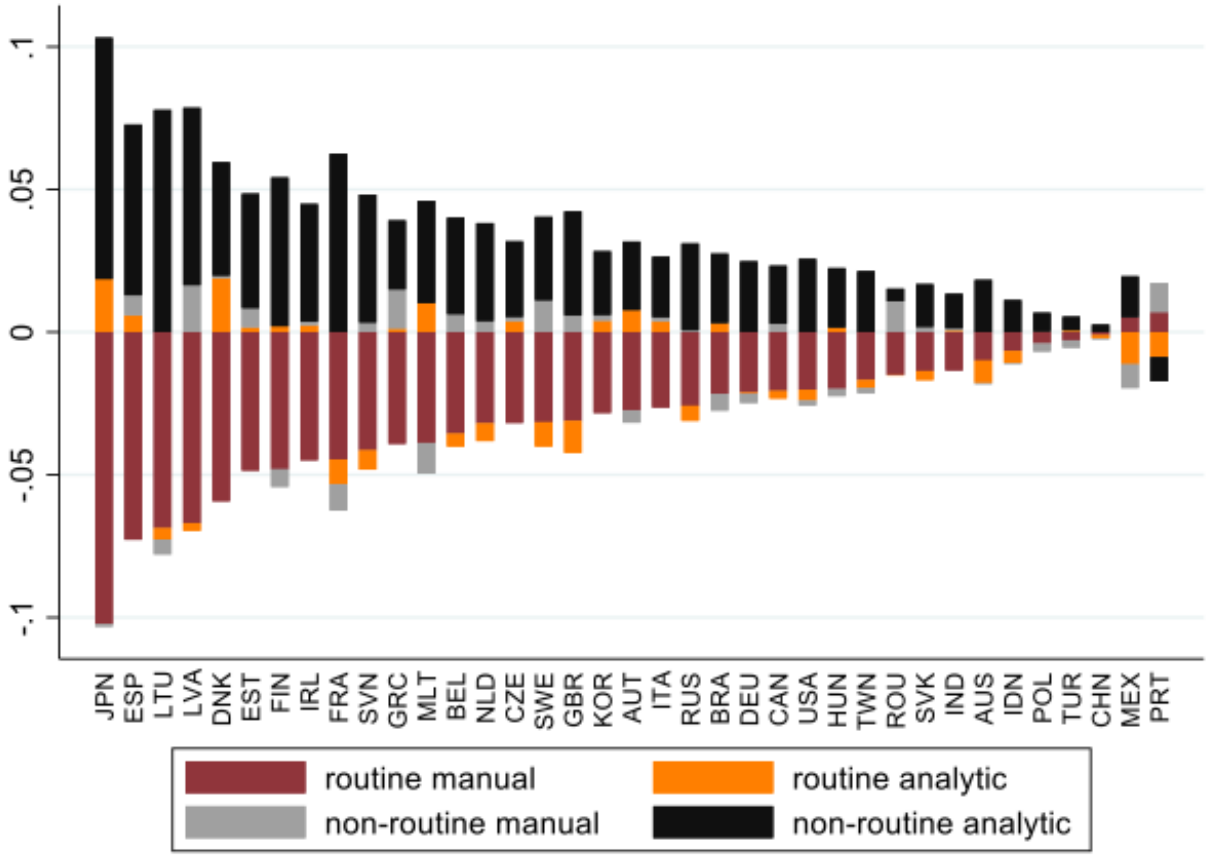
Firms produce a variety of products using a continuum of tasks. Workers differ in their comparative advantage in performing tasks (Acemoglu and Autor 2011). For example, well-trained engineers have the right skills to perform non-routine analytic tasks, such as those that require problem solving. We use detailed data on the occupations of workers and group these into "routine" or "non-routine" and further into "analytic" or "manual", based on the prevalence of tasks performed on the job. Examples for this occupational classification are given in Table 1.

Table 1 Mapping of occupations to tasks (examples)

	Routine	Non-routine
Manual	Production workers	Drivers
Analytic	Administrative workers	Engineers

To provide an aggregate picture of the type of jobs prevalent in a given country, we sum over the different industries and calculate the employment share of occupations by task type. Figure 1 shows the percentage point change in the employment shares by country between 2005 and 2015. These countries represent economies in our dataset at different levels of economic development. Yet, in most countries the share of routine tasks has fallen – by about four percentage points on average.

Figure 1 Changes in employment shares by task type, 2005-2015



Notes: Change in employment share by task type and country between 2005 and 2015. For aggregation, industries included in the sample are weighted using their 2005 employment share within the sample for each country. Countries are sorted based on the change in the routine manual employment share.

Robots appear particularly suited to perform routine manual tasks, such as sealing, assembling, and handling tools. Our hypothesis is therefore that increased use of robots is more likely to have affected occupations that perform relatively more routine manual tasks – that is, recent technological advances have been biased, replacing workers in a widening range of (mainly) routine tasks. Furthermore, from this line of thought also follows a possibility to address endogeneity problems in the empirical analysis: the proportion of tasks in an industry that could potentially be replaced by robots may serve as an instrumental variable for actual robot use.

The rise of robots and the fall of routine jobs

We analyse the effect of robots on the employment shares of occupations across 19 manufacturing industries in 37 high-income and emerging countries. Similar to Graetz and Michaels (2018) and Dauth et al. (2019), we do not find an effect of increased robot use on total employment. In contrast, increased use of robots has a negative impact on the share of occupations that are intensive in routine tasks, especially manual routine tasks. This effect is of considerable magnitude: in an industry with a medium adaptation of robots, the proportion of employees with routine tasks drops by two percentage points more than in an industry that did not install additional robots between 2005 and 2015. The effects are even larger when we estimate using instrument variables.

The effect of robots on jobs appears to be largely driven by task content rather than by education level. For a smaller set of countries, we were able to break down the group of production workers more precisely by their routine intensity. This is an interesting group to consider, as production workers might also be considered blue-collar workers and the impact of robots could therefore reflect a substitution of robots for blue-collar production workers. However, we find that the more weight we put on routine tasks, the larger is the employment impact of robots for this group of workers. This suggests that robot adoption is related to a decline in the share of occupations with a higher content of routine tasks. Moreover, it suggests that higher education per se is not a sufficient bulwark to mitigate the impact of robots on jobs. It is important to focus on the skills that workers learn.

Do robots foster a reshoring of jobs?

Firms are more likely to adopt robots if it is technically feasible and the profit gains exceed the costs of purchasing and installing the robots. Hence, improvements in robot capabilities are expected to result in a larger employment response in high-income countries, where wages are higher compared to emerging countries. Indeed, we find that robot adoption lowers the employment share of routine manual occupations in high-income countries, but not in emerging market and transition economies.

Yet, workers in emerging economies might be indirectly impacted by robots in high-income countries: The adoption of robots in high-income countries could bring back production tasks that had previously been offshored (Faber 2020). For example, the new ‘Speed factories’ built by German sportswear company Adidas in Ansbach (Germany) and Atlanta (US) produce thousands of shoes per year using industrial robots and rely on just a handful of workers. Previously, such production tasks would have taken place in locations with cheaper labour, such as Southeast Asia. In line with this, Baldwin and Forslid (2020) argue that robots lower demand for production tasks worldwide, but related technological advances in robotics and artificial intelligence could result in more service tasks being done remotely. Nowadays, for many of us, “remotely” means tasks being done at home but within commuting distance from the

office. Yet, remotely could also come to mean across national boundaries. Clearly, we need better measurement and understanding of the implications of recent technological advances for development. Providing new insights into how robots shape the international division of labour is an important area for further research.

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