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Robots, AI, and Immigration – A Race for Talent or of Displaced Workers

KEY MESSAGES

- **Adoption of new technologies can affect different skill groups differently, potentially increasing inequality between migrant and native populations**
- **New technologies often create skill shortages**
- **Industrial robots and artificial intelligence have important beneficial labor market effects on natives, but not migrants**
- **We observe an increase in the immigrant inflow as a response to AI adoption**
- **Policymakers should pay special attention to the migrant population when designing mitigation policies in response to automation**

Technological change and innovation are not recent phenomena: they have been part of human evolution since the Stone Age. While during the early periods of human development technological change was mainly limited to tools related to hunting, food gathering and preparation, as well as survival, over time there have been many transformative changes driven by technology. Examples are the invention of electricity, airplanes, the telephone and television, and nuclear fission, among many others. More recent examples form part of the digital revolution, which started after the Second World War, and comprises the Internet and personal computers, social media, smartphones, and digital TV.

Technological change can have overall positive welfare effects but might impact certain groups in society more negatively than others. Economists often define technological change as an innovation-driven increase in output using the same amount of inputs (Seo 2018). This can have important benefits for societies undergoing technological change (Callaghan 2021).

Conversely, some studies show that technological change can have adverse impacts on certain groups of society.[1] These adverse effects can occur when some technologies have the potential to replace tasks. One case in point: industrial robots replacing certain manual operations in the production process. Furthermore, artificial intelligence has the potential to replace cognitive tasks, as in the case of automated detection of spam emails. At the same time, technological change can create complementary tasks: an industrial robot needs to be operated and supervised, while an algorithm needs to be updated and verified. Lastly, technological change can result in productivity increases. Employees can use the time saved from no longer having to identify spam emails for more productive purposes. And the employment of industrial robots for industrial production might make it possible for one employee to oversee the manufacturing of more goods than when doing so manually.

The focus of our study is to examine whether and how the impact of technological change differs for migrants and natives. Researchers have mainly focused on different skill groups when studying the differential effects of technological change. This means that they have mainly focused on the low-, middle-, and high-skilled population when analyzing the potentially diverging impact of technologies. We bring a new aspect to these analyses by asking how the impact of technological change differs for the native and migrant population. This is of interest since, as migrants do not have access to the same networks and institutions as the natives (Wang et al. 2018), they tend to experience down-skilling (Borjas 2001), whereby they might be affected more significantly by the potential displacement effects of technological change. Furthermore, technologies can have the potential to raise some of the additional labor market barriers that migrants face. Examples are recruiting software or technologies that automate the translation of different languages. Lastly, there is evidence showing that technological change

[1] The studies by Autor et al. (2003), Graetz and Michaels (2018), Acemoglu and Restrepo (2018), and Dauth et al. (2019) give a good introduction into the literature.

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has created skills mismatches.[2] The resulting scarcity of skills makes it interesting to study whether the adoption of new technologies affects immigration inflows. The underlying rationale is that firms could try to cover potential skill shortages by recruiting suitably skilled workers from abroad.

To shed light on this issue, we have studied the impact of two different automation technologies – industrial robots and artificial intelligence – on labor market outcomes and immigration flows. We first focused on industrial robots, which rank as a form of low-skilled automation technology. Other type of robots has the potential to replace some human tasks, especially at the lower end of the skill distribution (Acemoglu and Restrepo 2018). To measure a labor market's exposure to robots, we used data on the operational stock of robots provided by the Industrial Federation of Robotics, which measures the number of installed robots in different industries in a respective year.

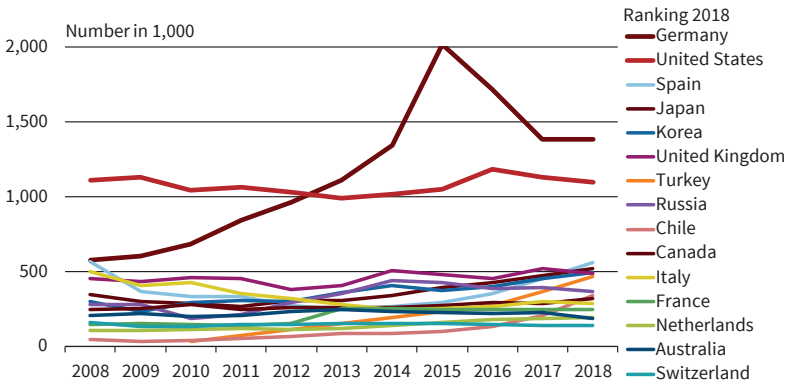
Next, we analyzed the adoption of artificial intelligence. In contrast to industrial robots, artificial intelligence has the potential to perform high-skill tasks (Webb 2019). To this end, we leveraged online job vacancy data provided by the company Burning Glass. We identified the AI-related skill demand through a number of AI-related skills. As soon as one of these skills was mentioned in a job vacancy, we defined it as a job vacancy demanding artificial intelligence. We then followed the demand for AI-related skills as well as the employment of industrial robots over time.

We chose to apply our study to the case of Germany, as it provides the ideal setup for the underlying research question. First, it is one of the main migrant-recipients among OECD countries (see Figure 1). Second, it is one of the leading countries in the adoption of automation technologies (see Figure 2).

We then combined our data on industrial robots and artificial intelligence with labor market data from Germany. We measured our labor market outcomes of interest using matched employer-employee data provided by the Institute of Employment Research (IAB). More concretely, we made use of the Sample of Integrated Labour Market Biographies (SIAB), which is a 2-percent random sample from the Integrated Employment Biographies (IEB). This data represents the German social security data tracking all employees subject to social security contributions, marginal part-time employment, officially registered jobseekers, as well as benefit recipients. We used this data to measure our outcome variables of interest: unemployment rate of migrants and natives, daily wages of migrants and natives, as well as immigrant inflow. We applied state-of-the-art econometric methods to investigate the impact of technological change on our outcome variables of interest.[3] Importantly, we conducted our analysis at the county level. Figures 3 and 4 show that there has been significant variation in the adoption of these two technologies over time.

Figure 1

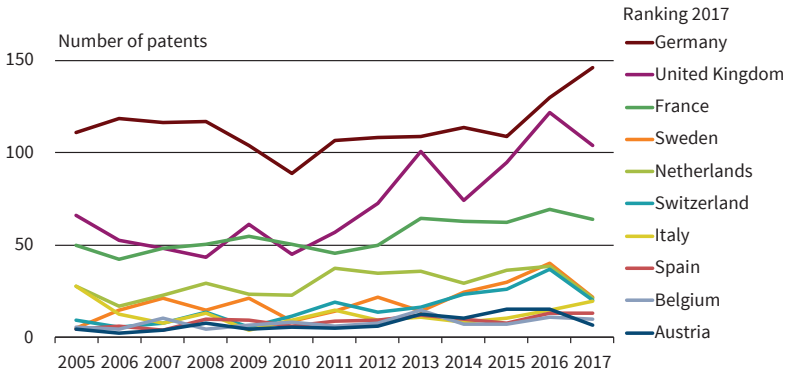
Immigrat Inflow



Source: OECD (2021). © ifo Institute

Figure 2

Technologies Related to Artificial Intelligence



Source: OECD patent data (2021). © ifo Institute

DIVERGING EFFECTS OF TECHNOLOGICAL CHANGE ON MIGRANTS AND NATIVES

The Impact of Industrial Robots

We find that robot adoption did not result in a significant increase or decrease of immigrant inflows in Germany during the 2005–2018 period, but they did have adverse effects on migrants who were already in Germany. While no displacement effects were observed for either migrants or natives, there was a significant impact on daily wages. While natives experienced a wage increase – a clear indication of productivity increases – this was not the case for migrants. On the contrary, they experienced wage declines as a result of robot adoption. Additionally, differently from natives, migrants do not seem to benefit from productivity increases. Possible reasons for this are that migrants might have less access to information on the need to

[2] As an example, firms in Germany spent on average six months filling tech positions.

[3] We applied a shift-share instrumental variable strategy. For an overview of the shift-share instrument, see Goldsmith-Pinkham et al. (2020).

Figure 3

Artificial Intelligence

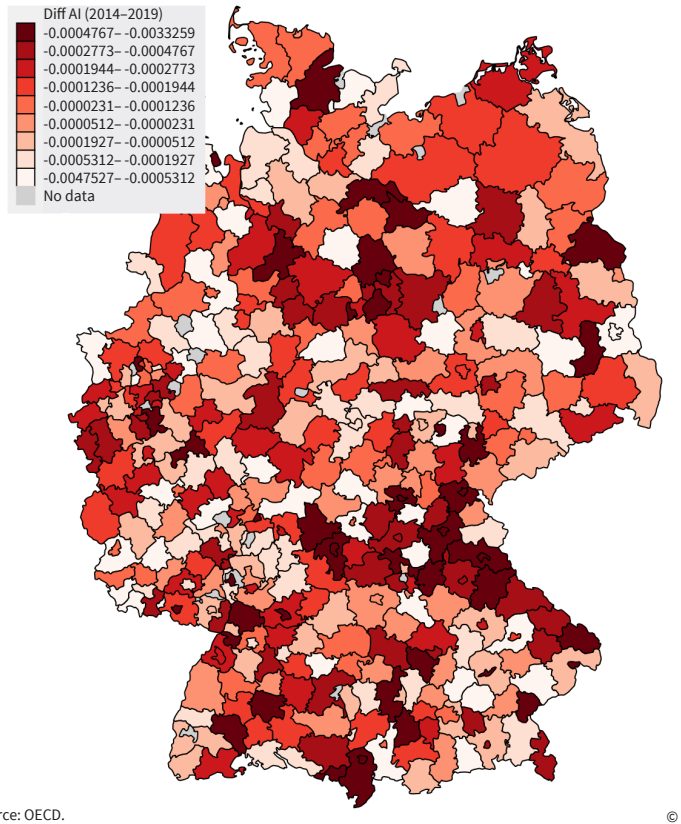


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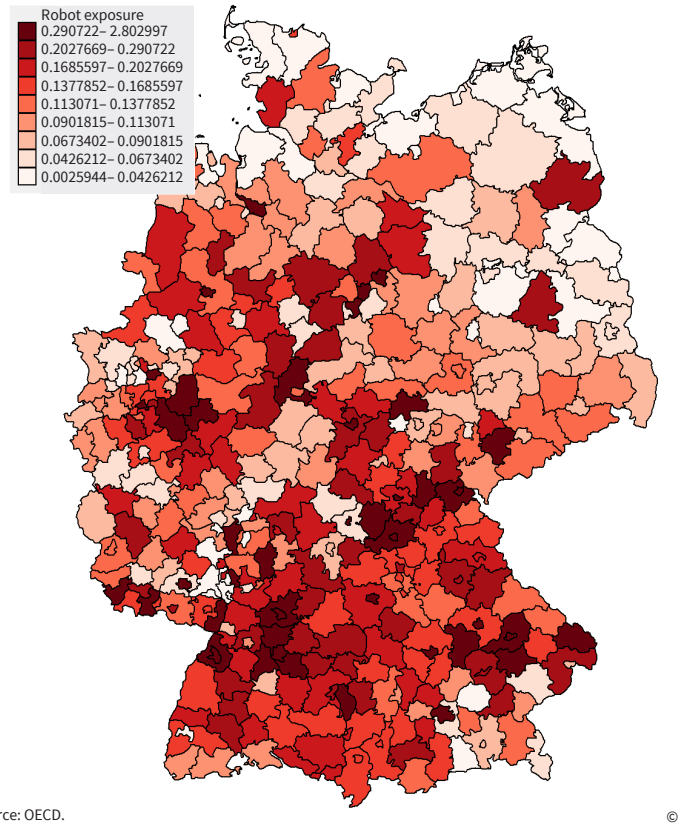
Figure 4

Robot Adoption



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adapt their skill set or to switch jobs; language barriers; or discriminatory labor market structures. When splitting the analysis by economic sectors, we find evidence of a migrant share decrease in the manufacturing sector, which is where robots are mostly installed. A decrease in the migrant share could result from migrants leaving the most exposed sector as a response to robot adoption or leaving Germany altogether.

Artificial Intelligence

Differently from robots, exposure to an increase in AI demands during the period 2014–2019 results in an increase in immigrant inflows, while also having adverse effects on natives and migrants. This could mean that firms face skill shortages due to AI, which they cover from abroad. Surprisingly, this effect is only significant for the medium- and low-skilled, pointing towards complementarity effects. Next, we find adverse effects on the labor market outcomes – namely the unemployment rate and daily wages – of migrants versus natives. This applies to all skill groups investigated. These findings indicate that – in line with our results on the impact of robot adoption – AI leads to productivity increases for natives, while negatively affecting migrants. Similarly to what we showed for robot adoption, potential drivers could lie with migrants having less access to labor market institutions, to information on how to adapt their skill set as well as to local networks.

POLICY CONCLUSIONS

Our findings show that automation has diverging effects on migrants and natives, likely driven by the fact that natives benefit from complementary and productivity effects of technological change, while migrants start competing with technological change. Consequently, inequalities between natives and migrants could increase as a consequence of technological change.

We also found a significant increase in the immigrant inflow as a response to AI adoption, which could be due to firms facing skill shortages that they cannot cover through the local labor supply, prompting them to tap the global labor market for the skills they require.

The key policy implications resulting from the above are:

(1) Policymakers interested in equity between migrants and natives should pay special attention to the migrant population when designing mitigation measures in response to technological change.
(2) It is advisable to introduce policies to ensure that migrants enjoy equal access to labor market institutions and networks as the natives. Mentoring programs could be a useful way to achieve this (Weiss and Tulin 2021).

(3) Policymakers should also make sure that migrants have equal access to relevant information about how to adapt their skill sets, as well as securing their access to retraining programs.
(4) In general, measures that target the enforcement of the "Equal Pay for Equal Work" principle between migrants and natives are recommended.
(5) The development of sound migration policies, which make it easy for firms to recruit the best talent abroad, is desirable.

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