Don't blame it on the machines: Robots and employment in Europe

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Opinion polls reveal that Europeans are greatly concerned about the economic consequences of advanced technologies, but our understanding of this relationship is still incomplete. This column assesses the impact of one such technology – industrial robots – on employment in Europe over the last two decades. Combining industry-level data on employment with data on robot adoption, it finds that robot use is linked to a small but significant increase in employment. Contrary to some previous studies, it does not find evidence of robots reducing the share of low-skill workers across Europe.

In the last couple of decades, the Digital Revolution has unleashed rapid progress in many advanced technologies such as artificial intelligence and robotics. Especially in the aftermath of the Great Recession, this has sparked an intense debate on the future of work, both in academic circles and amongst the general public. In this debate, the image of robots replacing workers – most notably, low-skilled workers – is a recurring theme. For instance, according to a recent Eurobarometer survey 72% of Europeans believe that "robots and artificial intelligence steal peoples' jobs" (European Commission 2017).

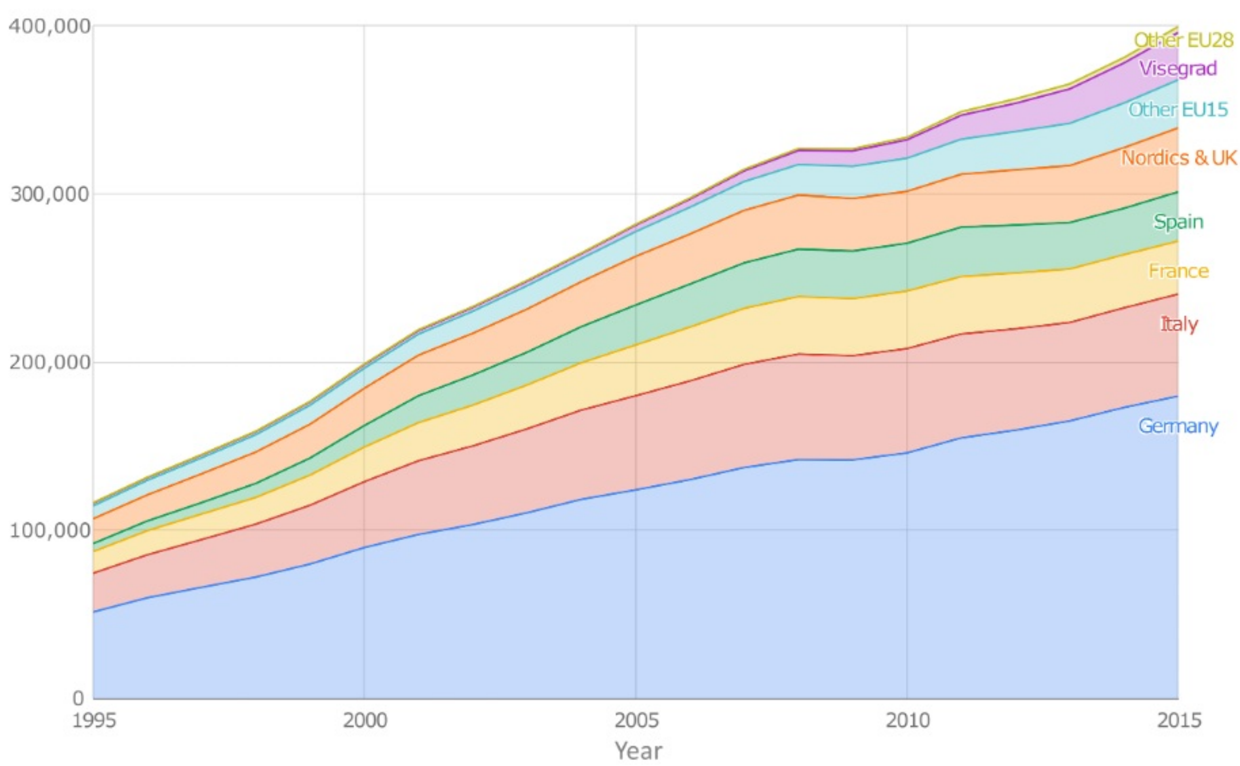
Until recently, there were few reliable sources of data on the use of robots that would allow for an empirical analysis of their impact on employment. But in the last few years, the International Federation of Robotics (a global association of robot producers) has provided data on the deployment of one such technology – industrial robots – by country and industry, starting in the early 1990s (IFR 2019). There have been several papers published in recent years based on this dataset that report significant negative employment effects of robots. For instance, Acemoglu and Restrepo (2019) find that each robot installed in the US replaces six workers; Chiacchio et al. (2018) find a replacement rate of between three and four workers per robot in Europe using a similar approach.

This column summarises the main findings of our recent study analysing the effect of industrial robots on total and low-skill employment, using more up-to-date data on robots and employment and relaxing some of the assumptions of earlier studies (Klenert et al. 2020).

Industrial robots in Europe

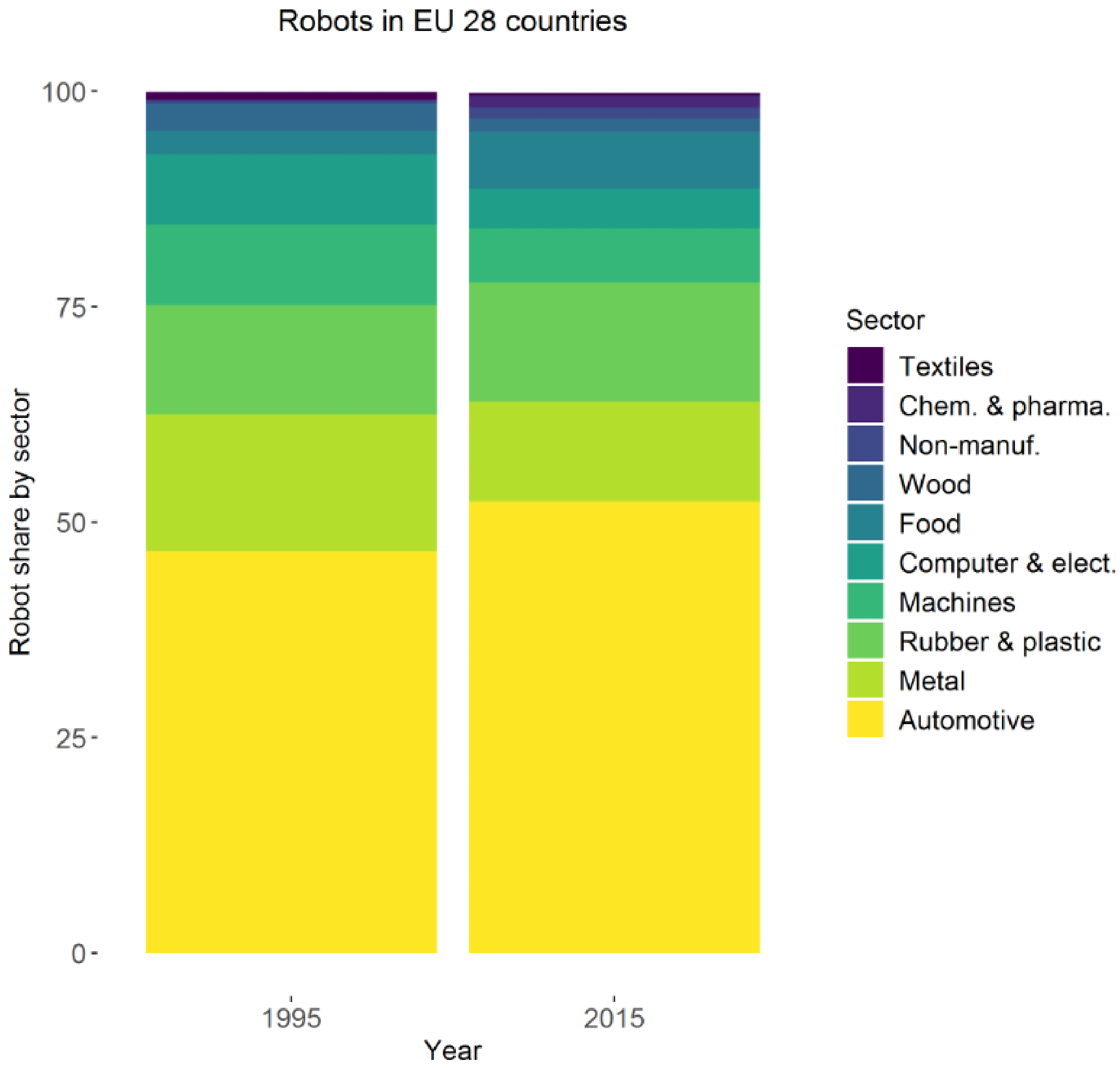
Industrial robots can be characterised as more or less stationary reprogrammable robotic 'arms' that perform manual tasks such as handling, welding, and moulding. They are far from humanoid robots in any sense.[1] These types of industrial robots have been around since the 1980s, but their broad deployment took place over the last two and a half decades (see Figure 1). The overwhelming majority of industrial robots are used in manufacturing, with the automotive sector (NACE Rev. 2 sectors 29-30) accounting for roughly half of the operational robot stock in Europe in 2015 (see Figure 2).

Figure 1 Robots in operation in different EU countries



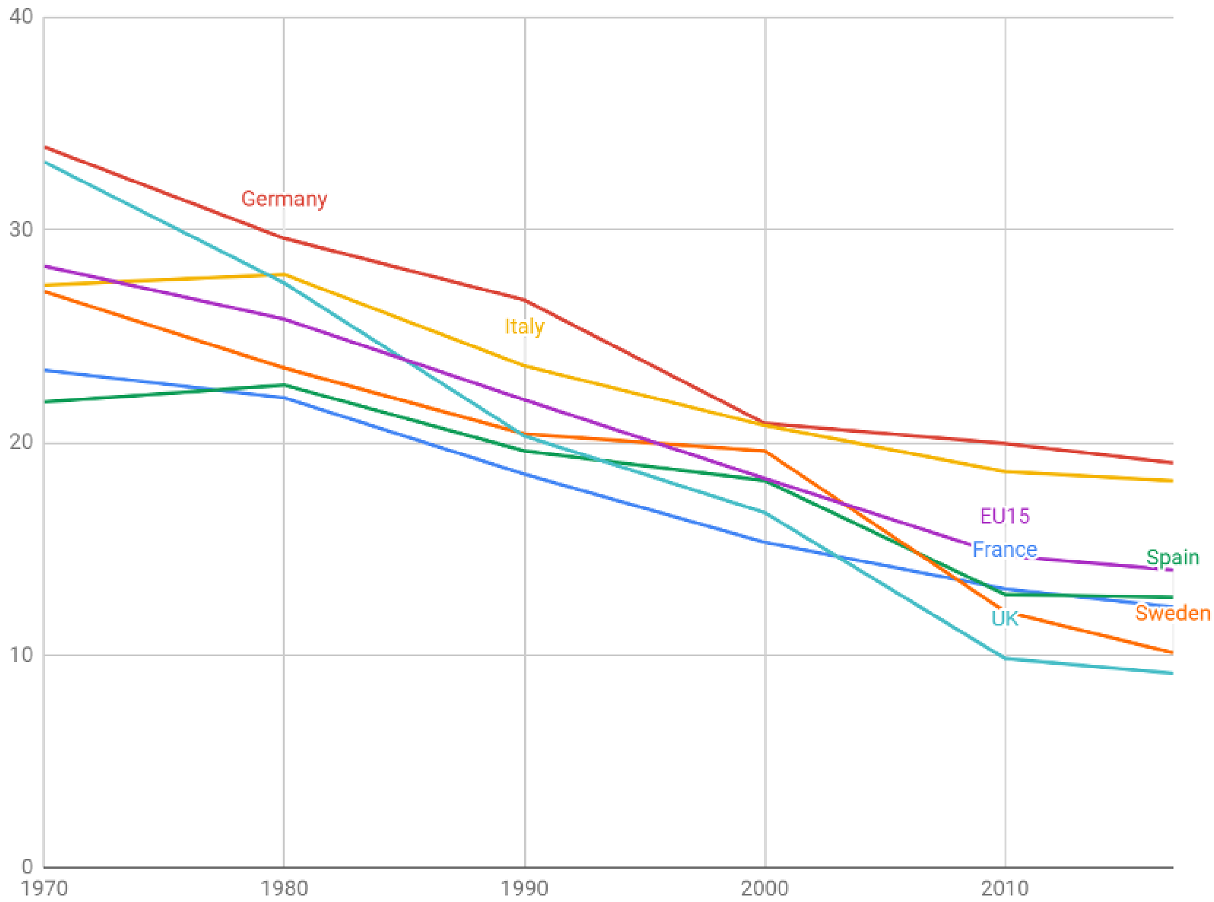
Note: Countries are grouped as follows. Nordic countries and UK: Denmark, Sweden, Finland, UK. Other EU15: Austria, Belgium, Greece, Ireland, Netherlands, Portugal. Other EU28: Bulgaria, Croatia, Estonia, Latvia, Lithuania, Malta, Romania, Slovenia. Visegrad: Hungary, Poland, Czech Republic and Slovakia. Luxembourg and Cyprus are not contained in the sample.

Figure 2 Distribution of robots by sector as a share of total robots



Since the 1970s, the share of employment in manufacturing in Europe has been consistently decreasing relative to other sectors (see Figure 3), while the number of industrial robots has been on the rise since the mid-1990s (Figure 1). Whether robots have contributed to this trend and, if so to what extent, can only be answered by a thorough econometric analysis, taking into account structural differences between countries and industries, as well as parallel trends regarding the formation of ICT capital, the capital/labour ratio, and other factors.

Figure 3 Employment shares of manufacturing in Europe



There have been several studies on this subject in recent years, which can be classified by the type of data used. Studies based on microeconomic data tend to find a neutral or positive correlation between employment and robot deployment, suggesting a complementarity between robots and jobs, even for low-skilled employment (Dauth et al. 2017, Domini et al. 2019, Jäger et al. 2016, Koch et al. 2019). By contrast, studies relying on aggregate data – usually measured at the sectoral and national level – tend to find a negative correlation between robots and employment, especially for low-skilled workers (Acemoglu and Restrepo 2019,Chiacchio et al. 2018, Graetz and Michaels 2018).

Robots and employment

Despite the fact that we also rely on aggregate data, our analysis shows that in Europe, in the period 1995 to 2015, industrial robot use is positively associated with total employment.[2] One additional robot per 1,000 workers (in 1995) is correlated with an increase in total employment of 1.3 (+/−0.2)%. Furthermore, we find no evidence of a negative relationship between robot use and low-skill employment, which also contrasts with some previous studies. Our results are very robust across a wide range of assumptions, estimator choices, sector selections and time periods.

There are several factors behind this outcome. First, even if robots are a labour-saving technology, they can induce demand effects that can lead to employment growth (Bessen 2018). Second, investment in robots and employment may move together, since both reflect underlying variables such as the resilience, competitiveness, or innovative capacity of national industries. Third, robots and automation technologies generally do not replace entire jobs but only certain tasks (Acemoglu and Autor 2011, Tolan et al. 2020). This may lead to a restructuring of the task content of different jobs, enhancing labour productivity and, potentially, employment.

With regard to earlier findings, our results are more in line with studies based on microeconomic data (Domini et al. 2019, Jäger et al. 2016, Koch et al. 2019). By contrast, some of our results differ significantly from studies using similar aggregate data, most importantly Acemoglu and Restrepo (2019), Chiacchio et al. (2018) and Graetz and Michaels (2018). In the full paper, we discuss in detail the reasons behind these differences, mostly due to the different data sources used (we use the EU Labour Force survey for all employment analysis), the fact that we cover eight or more additional years and that we relax some key assumptions of those earlier studies (for instance, with respect to how robot density is calculated for each sector and country).

There is significant variation between sectors both within and between countries, which is the reason why in our analysis we account for specific country-sector characteristics by including country-sector fixed effects. When these structural differences are not accounted for, we still find positive (and in most cases, significant) correlations between total employment and robotisation, but the explanatory power is lower. Furthermore, to account for macroeconomic trends such as economic crises or a general downward trend in manufacturing jobs that affect all sectors to a similar extent, we control for time fixed effects that are not country or sector specific. If time trends are not controlled for, these general negative employment trends can be wrongly attributed to robotisation. In general, our results are very robust with regard to including additional control variables (such as the ICT capital share, capital accumulation, capital/labour share), including non-manufacturing sectors, using different time periods, using different calculations of the stock of robots, using different indicators for robotization, and using different estimators.

There are some caveats to keep in mind when interpreting these results. First, these findings refer to recent and ongoing trends, but cannot be generalised into the future. The kinds of industrial robots analysed in this study have been around since the 1990s and should not be confused with more advanced technologies such as robots enhanced by artificial intelligence, which are not yet deployed at a significant scale. Once they are used in mainstream manufacturing, such technologies may have more disruptive potential. Second, since the overwhelming majority of industrial robots is used in manufacturing sectors, we cannot interpret these results outside of the manufacturing context. That said, the use of robots outside manufacturing is still mostly experimental or anecdotal and has only limited economic significance at the moment (of course, this could and possibly will change in the future). Third, the positive correlation between robotisation and employment is significant and robust but small compared to other variables. Fourth, we could not find a convincing instrumental variable (IV) for robot adoption so we cannot claim causality in the relationship between robots and employment. However, most previous research on the impact of robots on the labour market does not report significant differences between OLS and IV estimates, and our main findings hold for many different OLS specifications.

Summary and policy implications

In summary, we found no evidence that industrial robots have destroyed jobs or reduced the employment share of low-skill workers in Europe in recent years. In fact, robot adoption tends to be positively associated with aggregate employment, although the relationship is small compared to other factors affecting European employment in recent years.

This has important implications for policy. Blaming robots – or in a broader sense, automation – for recent troubling developments in European labour markets, such as rising wage inequality or the polarisation of employment opportunities, may shift public attention from other, more prominent causes such as labour market deregulation, the weakening of collective bargaining structures or a general lack of public spending (Mishel and Bivens 2017, Krugman 2019). The obsessive focus on robots and automation in the recent debates on the future of work may have also contributed to unjustified feelings of economic anxiety and fatalism, potentially damaging the political debate. Finally, our findings also suggest that recent policy proposals, such as a specific tax on robots, might in fact be ineffective for its own purposes and counterproductive in other ways, since robot use is associated with increased productivity (Graetz and Michaels 2018, Jungmittag and Pesole 2019).

Authors' note: The views expressed in this column are those of the authors and cannot be taken as representing the official position of the European Commission.

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Endnotes

1 An industrial robot is defined by the International Organisation for Standardisation as "an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications" (ISO 8373:2012).

2 Our analysis combines annual data on robot installations in Europe from the International Federation of Robotics (IFR) with data on aggregate employment and employment by skill level from the EU Labour Force Survey (EU LFS). Additional control variables are taken from EU KLEMS growth and productivity accounts. The resulting sample covers the years 1995 to 2015, 14 different sector aggregates and 14 EU countries.