The Impact of Robots on Labor Market Transitions in the EU

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New technologies have significantly changed the labor market and the way we work. While they replace workers in certain tasks, they can amplify workers' productivity in others and lead to the creation of new jobs. However, there is ongoing fear that the creation of new jobs cannot outweigh the displacement of old jobs. Robot technology is often considered a particular threat due to its rapidly increasing task set and its capacity to work without human supervision. Just between 2000 and 2016, robot density as measured by the number of industrial robots per 1,000 workers has risen from 0.32 to 1.37 in Europe as a whole, and from 2.03 to 3.78 in Germany, the country with the highest number of robots in Europe.

In their seminal paper on the effect of robots in several industrialized countries, Graetz & Michaels (2018) found no significant effect on total employment but a positive productivity effect. At the country-level, the effect of robots on local labor-markets has been analyzed for the US (Acemoglu and Restrepo, 2020) and for Germany (Dauth et al., 2019). While evidence for the US shows a significantly negative effect of robots on employment, Dauth et al. (2019) find no significant effect for Germany. Instead they show that robot adoption leads to a reassignment of workers to new jobs within a firm and the reallocation of workers between sectors. However, up to now there is no evidence on mechanisms behind potential changes in employment levels such as job loss and job finding at the worker level for a large number of industrialized countries. In a first step, we are interested in different employment effects across European countries and the impact on different groups of workers. In a second step, we examine which role labor market institutions play and if they can mitigate negative employment effects.

For our analysis, we use the European Labor Force Survey (EU-LFS) for the years 1998 to 2016. Due to data limitations, we restrict our analysis to the following 18 countries: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Slovakia, UK. The EU-LFS provides data on an individual's labor market status in the current and previous year that we use to create labor market transitions as in Bachmann et al. (2015). Additionally, the dataset provides rich information on the socioeconomic background of individuals which allow us to investigate the effect of robots for different groups of workers.

The data on robots is obtained from the International Federation of Robotics (IFR). They provide annual information on the current stock and the deliveries of industrial robots across countries and sectors (IFR, 2017). We control for macroeconomic conditions using data on GDP growth and gross value added from EU KLEMS (Stehrer et al. 2019) and account for the effects of globalization using trade data from the UN Comtrade database. To investigate the role of labor market institutions, we use data provided by the OECD (OECD 2020) and ICTWSS (Visser 2019).

We use a probit model to analyze the effect of robots on the probability of making a transition between employment and unemployment and vice versa. Importantly, we allow the effects of robots to vary between countries at different levels of development. This takes into account that the worker-displacing effects of robots may well depend on the production costs prevailing in a particular country. To this aim, we use two measures of the initial conditions of a country - GDP per capita and labor costs in 2004 - and interact them with robot exposure. For a causal interpretation of the results, we are concerned about factors such as industry-specific shocks that affect robot adoption and the transition probability out of or into an occupation concurrently. We address this issue by following an approach previously applied by Acemoglu & Restrepo (2020) and Dauth et al. (2019) and instrument robot adoption with robot adoption in other (advanced) economies. Therefore, in our analysis we instrument robot density in Eastern (Western) European countries with the average robot density in other Eastern (Western) European countries in our sample.

Our preliminary results indicate an overall negative effect of robot density on the probability of job separation in European countries. However, the estimated coefficient for the interaction term between robot density and the country's initial condition shows that this effect significantly varies between countries at different development levels. In particular, we find that a higher robot density leads to more job separations in countries which had a relatively high level of GDP per capita in 2004. On the other hand, for the least developed countries in our sample, the opposite is the case.

For the probability to make a transition from unemployment to employment, our results instead show an overall positive effect of robot density but a negative effect for the interaction term with the initial condition. This implies that robot density lowers the probability to make a transition out of unemployment in countries who had a relatively high GDP per capita in 2004 but increases the probability to become employed in poorer countries in our sample.

When we control for 2004 labor costs, the results are consistent with the results described for GDP per capita. Importantly, the results of the instrumental variable estimation confirm the findings of the simple probit model and suggest that the described effects are not driven by reverse causality.

Our next steps involve identifying differential effects on individual workers, e.g. with respect to age, education, gender, and job tasks and to investigate the importance of labour-market institutions.

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