Robots at the Tropics*

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EXTENDED ABSTRACT

In recent years, a growing concern has emerged regarding the potential effects of Artificial Intelligence (AI) and robotization on firms, and even more specifically on workers and the risks for their displacement (Brynjolfsson and McAfee, 2014; Acemoglu and Restrepo, 2017; Graetz and Michaels, 2015, among others). The emphasis of current research studies has been driven by the rapid decrease in the prices of robots, that according to Graetz and Michaels (2015) fell by 2005 to one fifth of its 1990 level adjusting for quality. Consequently, utilization of robots has increased in a wide range of different industries, with the operational stock of robots doubled between 2005 and 2016, reaching 1,828,024 units by the end of 2016 and expected to reach three millions by 2020 (International Federation of Robotics, 2017).

The evidence on the impact of robots on the global economy is still very limited and the results of recent studies exhibit great differences. For example, while Frey and Osborne (2017) indicate that the number of jobs that are in risk of automation could account for around 50%, Arntz et al. (2017) argue that this figure is overestimated due to the fact that the heterogeneity of tasks within occupations is not considered, which would reduce this number to around 9%.

A study conducted by Graetz and Michaels (2015) using a panel of 17 developed countries has found positive and robust effects of robots over labor and total factor productivity, but the effects on employment

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are not very clear as they only find negative effects in the case of low and middle-skilled workers and do not find evidence of job polarization. Acemoglu and Restrepo (2017) analyze the effects of robotization on the U.S. local labor markets and find that commuting zones that were highly-exposed to robots during the period of 1993-2007, exhibited high and robust negative effects on employment and wages. The importance of careful empirical analysis stems from the complexity of the relations between the labor markets and firm-level productivity, which makes impossible to determine the direction of the effects *a priori*. As Acemoglu and Restrepo (2017) show in a model to explain the possible labor outcomes of automation, in the case of jobs there are at least three possible effects that are likely to occur at the same time. First, a displacement effect, which will result in a reduction of demand for employment. Secondly, a productivity effect which lead to an increasing demand for workers, and thirdly, there is a scale-effect due to the expansion of all industries in the commuting zone which also has a positive effect on employment.

Considering the recent mushrooming of studies analyzing the effects of automation and robotization, we observe that all the evidence has so far focused on advanced countries, which started their process of automation more than 20 years ago. However, as the impact may vary depending on the characteristics of the local labor market, it is important to analyze how different the effects may be in the case of developing countries, where wages are lower and, thus, the benefits of automation are more limited. The case of Mexico is particularly interesting as it is one of the countries that is more exposed to the use of industrial robots among emerging economies, with an operational stock according to the IFR of more than 20,000 units, which is 30% higher than in India, double than Brazil, and ten times higher than Argentina. Furthermore, robot sales in Mexico reached a new peak of 5,900 units during 2016. For this reason, the main research question addressed in this paper is to assess the effects of robotization on jobs, salaries and firms in the context of a developing country such as Mexico, which is still in a much earlier stage of automation, similar to the U.S. in 1996.

To calculate robots density, we use the same source of information as Acemoglu and Restrepo (2017) and Graetz and Michaels (2015), relying on data from the IFR on the operational stock of robots at the country-industry level. An important characteristic of these figures, as pointed out by both studies, is that it only includes automatically controlled, multipurpose industrial robots which are susceptible to being reprogrammed to perform other tasks. Using these data, we follow Acemoglu and Restrepo (2017) and calculate the exposure to robots at the commuting zone level using the sectoral density of robots along with baseline sectoral employment shares for each commuting zone. Though recent analyses based on developed countries restrict the time framework to data before 2007 in order to avoid confounding effects derived from the 2008 financial crisis, in the case of Mexico we use data from 2005 to 2016 as this is the period where a surge in automation is observed for Mexico. The choice of analysis of our time period is also driven by data availability as employment surveys started to be statistically representative at the commuting zone level only

in 2005, and IFR does not provide robots data for North America disaggregated at the industry-level before 2004.

Data on employment and wages are obtained from the National Occupation and Employment Survey (ENOE), this is a quarterly survey which allows us to calculate yearly averages between 2005 and 2016 to match our exposure to robots data. This dataset includes employee-level information on employment status, sector, wages, occupations and other sociodemographic data such as age, education, and sex, which we want to exploit further in later stages of this project. Finally, we complement these worker-level data relying on establishment-level data from the 2004, 2009, and 2014 Economic Censuses, which allows us to analyze the impact of robotization on firms.

Our preliminary results indicate that differently from the results observed in Acemoglu and Restrepo (2017), in the case of Mexico we find that the adoption of robots does not reduce employment, but it increases it and the results appear to be driven by the effects on high-skilled workers. Within the model developed by Acemoglu and Restrepo (2017) this could be due to the productivity increases derived from automation which could lead to a labor demand increase. This is consistent with conclusions from McKinsey Global Institute (2017), suggesting that automation is less attractive in countries with low-wages such as Mexico, so another possible explanation could be that Mexico is in a much earlier stage of robotization, and thus, the predominance of the displacement effects observed for the U.S. have not yet materialized.

Going forward in our analysis, we plan to dig further into the effects of automation on wages and employment, analyzing skills, occupations and tasks in order to disentangle the mechanisms behind the preliminary results, especially in light of the sharp contrast with the results for the U.S. and other developed countries (Graetz and Michaels, 2015; Acemoglu and Restrepo, 2017).

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