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EXTENDED ABSTRACT

Title:

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Abstract: *(minimum1500 words)*

Two key economic trends have accompanied the sharp drop in manufacturing employment in developed countries: a massive increase in imports from low-wage countries, particularly China, and a continued growth in industrial robotization. Spain isn't an outlier in this regard. For example, between 1993 and 2019, the operational stock of robots in the Spanish automobile industry increased by about tenfold. Furthermore, vulnerability to Chinese imports for Spanish manufacturers. Furthermore, the share of Chinese imports by Spanish manufacturers increased from 2.9 percent to 7.7 percent between 1999 and 2007, putting China among Spain's top four importers. As a result, debates on the relationship between Chinese imports and unemployment, as well as robotization and unemployment, have dominated economic study and influenced public policy.

This research investigates how the exposure of Spanish Local Labor Markets (LLMs) to robotization and Chinese imports affects the demand for manufacturing labor. These two economic factors, curiously, have varied intersecting effects and influence employment demand in opposite directions. To illustrate the dilemma, despite the fact that the operational stock of robots in the automotive industry has multiplied tenfold, the car sector accounted for 8.7% of Spanish gross product in 2015, up from 5.2 percent in 2005, and this promising industry employs about 9% of Spain's total labor force (Méndez-Barreira, 2016). As a result, it's critical to separate the relative relevance of each phenomenon in relation to employment patterns.

While prior research has found that exposure to Chinese imports and industrial robots has a statistically significant influence on manufacturing jobs, the magnitude and nature of this impact varies greatly. In several analyses the negative impact on employment appears to be inevitable, yet, this is not necessarily the case for all countries, or even the final result for total employment, as a growing body of research has suggested, the impact of each component was in the opposite direction of the other, all of this necessitates a more thorough analysis at a more disaggregated

level. Fortunately, this research represents a new geographical classification of the Spanish manufacturing industry, based on Spanish industrial districts, which may address not only variations between Spanish industrial districts but also cross-country comparisons.

This paper empirically investigates the impact of these two factors employing a regression analysis model, where the response variable is the change in manufacturing employment using Spanish manufacturing employment data over the period 2001-2018 at the LLM level, For the Spanish LLMs, we employ the classification proposed by Boix and Galleto (2005), and based on data from the Instituto Nacional de Estadística, we obtain 667 LLMs as the geographical unit of analysis. The main explanatory variables are exposure to imports from China and exposure to industrial robots over 12 Spanish industries.

It's worth noting that the Marshallian industrial districts inspired the classification of Spanish LLM (MID, Marshall 1890). Who claimed that the creation of industrial districts was due to the concentration of production, employment, skills, knowledge, suppliers, and enterprises in some districts of England cities, which produced external economies of scale for industries and encouraged them to centralize more. Boix and Galleto outline the boundaries of the Spanish industrial districts, emphasizing the importance of the Marchalian industrial districts, which account for 20% of total jobs and 35% of manufacturing jobs in Spain.

Data on industrial robots' operational stock are provided by the International Federation of Robotics (IFR, 2018), the definition of industrial robots by the IFR is based on the one provided by the International Organization for Standardization:(ISO 8373), whereas an industrial robot is 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¨. Accordingly, industrial robots are fully automated and don't need human intervention, the IFR (2018) estimates for operational stock provide data at the country and industry level (ISIC Rev. 4 codes) over the period 1993-2017. Data availability varies across countries, years, and industries, the earliest available data is considered during the selection of the most appropriate EU countries to be used in our estimation of instrumental variables.

while data on Chinese imports are drawn from COMEXT which is Eurostat's reference database that offers rich and detailed historical statistics about imports and exports in goods for intra-EU and extra-EU trade, goods are classified by the Statistical Classification of Products by Activity (CPA) and available at CN, SITC, CPA_2002, CPA_2008, CPA_2.1, we select CPA_2008.

To concord with industrial robots data and ICT data we aggregate the industry level to a 2-digit industry code.

Data on ICT brought by the EU KLEMS database, 2019 release, the EU KLEMS data is available at (NACE Rev. 2/ISIC Rev. 4) industry classification over the period 1995-2016, Unfortunately, the final two years of data in our estimation period are lacking. We collect data on capital stock for computing and communication equipment at 2010 real prices to measure ICT exposure.

A major difficulty in our estimates is the differences in the classification of industry codes and industry aggregation between COMEXT, the IFR, and the EU KLEMS databases, and to harmonize our data we aggregate two industries and exclude others to finally arrive at 12 Spanish industries.

Because this study is currently ongoing, data on immigration is lacking, and hence an estimate of immigration exposure is not yet possible.

We define import and robot exposure indices at an industry level analogously following the methodology used by Acemoglu and Restrepo (2017). Moreover, to disentangle the influence of ICT and immigration, our model include an estimation of Spain´s industrial exposure to ICT and immigration, both indices are computed similarly to exposure to Chines imports and robotization.

The baseline model estimated using ordinary least squares (OLS) with the Spanish exposure to robots and imports from China calculated using Spanish (sp) data as represented in the following equation

$$\Delta\gamma_r = \beta_0 + \beta_1 \Delta imp_{rt}^{sp} + \beta_2 \Delta rob_{rt}^{sp} + \beta_3 \Delta ict_{rt}^{sp} + \beta_3 \Delta imm_{rt}^{sp} + \beta_4 \Delta X_{rt}^{`} + \varepsilon_{rt} \quad (1)$$

Where $\Delta\gamma_r$ is even the log change in manufacturing employment or the variation in manufacturing employment share of the working-age population between 2001 and 2018, however, regression for multiple subperiods 2001-2007, 2007-2013, and 2013-2018 are considered as well, the subscript r indicate the LLM level. Δimp_r^{sp} is the Spanish industries exposure to imports from China, while Δrob_{irt}^{sp} is Spanish industries exposure to robots, $\beta_3 \Delta ict_{irt}^{sp}$ *and* $\beta_3 \Delta imm_{irt}^{sp}$ are respectively the exposure to ICT and immigration.

Exposure to Chinese imports and robotization indices for every local labor market (r) and industry (i) are:

$$\Delta imp_{irt}^{sp} = \sum_i \frac{empl_{irt}}{empl_{rt}} * \frac{\Delta imp^{sp}{}_{irt}}{empl_{it}} * 1000 \qquad (2)$$

$$\Delta rob_{irt}^{sp} = \sum_i \frac{empl_{irt}}{empl_{rt}} * \frac{\Delta rob^{sp}{}_{irt}}{empl_{it}} * 1000 \qquad (3)$$

Where $\left(\frac{empl_{irt}}{empl_{rt}}\right)$ *is the start of perid* (2001) *indudtry´s* (i) *share of total emplyment in region* (r), *and* $\Delta imp^{sp}{}_{irt}$ *is the change in imports from China between* 2001 *and* 2018 *for each industry* (i) *and region* (r), $empl_{it}$ *is total industry* (i) *employment at* 2001 *at a counrty level*.

Our investigation is carried out in stages, first, the ordinary least square model is estimated as in equation (1) including industries' exposure to ICT and immigration indices as control variables to reduce the noise in the error term (ε_{rt}), here, a further issue raised by the literature is the endogeneity issue leading to biased estimates, the Spanish industries exposure to Imports from China and industrial robots estimates could be correlated to the error term (ε_{rt}), since demand shocks are correlated to both robots and imports exposure, shocks to labor demand in an industrial district have an impact on whether or not to adopt industrial robots or import from China.
To eliminate any endogeneity concern, we replicate the estimation of the regression module using two new exposure indices, instead of Spanish data we use the industrial robots operational stock for six European countries as an Instrumental Variable method, we use data for France, the United Kingdom, Sweden, Denmark, Germany, and Italy.
Penetration of imports from China and industrial robots in the Spanish industrial districts have become as follows:

$$\Delta imp_{irt}^{EU} = \sum_i \frac{empl_{irt}}{empl_{rt}} * \frac{\Delta imp^{EU}{}_{irt}}{empl_{it}} * 1000 \qquad (4)$$

$$\Delta rob_{irt}^{EU} = \sum_i \frac{empl_{irt}}{empl_{rt}} * \frac{\Delta rob^{EU}{}_{irt}}{empl_{it}} * 1000 \qquad (5)$$

We use a 2SLS regression model in the second phase of the investigation, and because there is no evidence of a correlation between demand shocks in the EU and Spain, we expect the instrumental variable to be a good instrument.

The results of our estimates show a negative correlation between employment and Chinese import competition, whereas the opposite is true for industrial robot exposure; however, it should be noted that this research is still in progress, and no final results have yet been obtained from our estimates; however, we expect the results to be different when the research continues and a list of control factors is added, as well as a crucial explanatory variable that has yet to be added, immigration exposure.

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