Building nominal stocks of robots

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We build nominal stocks of robots in order to remove them from nominal stocks of other capital, thus avoiding double counting. In order to do this, we calculate for every country-industry in year t (omitting the country and industry subscripts):

$$\text{Nominal Robot Stock}_t = \sum_{n=0}^{11}(Inst_{t-n} \ * \ p_{t-n}) \tag{1}$$

where n are lags, $Inst_{t-n}$ is the number of robots installed in year $t-n$, and p_{t-n} is their price. We set the life span of robots to 12 years, which is the common assumption that is applied in the IFR data. Therefore, we need robot installments and prices dating back to 11 years before the year in which the stock is computed.

This computation implies no depreciation of robots until they are 12 years old, at which point they fully depreciate. An alternative is to assume proportional depreciation $(1/(n+1))$ or linear depreciation $(1-n/12)$ before age 12. We experimented with these alternatives. This made virtually no difference for the regression results in our paper Fontagné et al. (2023).

Robot installments, $Inst_{t-n}$:

IFR data report robot installments starting from 1993. Therefore, we impute installments back to 1982, i.e. 11 years before 1993. For the countries with no industry disaggregation on robots' data in 1993, we impute values back to 1993 following the procedure described in Graetz & Michaels (2018). Once computed for each country-industry the robot stock in units in 1993, $Stock_{1993}$, we linearly impute backward installments as:

$$Inst_{1993-n} \ = \ \frac{(Stock_{1993} \ - \ Inst_{1993})}{11} \tag{2}$$

for all $n = 1,2,\dots 11$ (for $n = 0$ we have $Inst_{1993}$).

Prices, p_{t-n}:

We source robot prices from Jurkat et al. (2021). We use prices for Germany dating back to 1990, due to Germany's dominance in robot supply. We assume prices of robots are equal across countries. Prices for other countries correlate significantly with those for Germany.

Since we do not have robot prices before 1990, we used the evolution of equipment prices between 1990 and 2000 for Germany to extrapolate backwards the price of robots to 1982. Robots are part of equipment, so using equipment price inflation is reasonable, under the assumption that robot prices evolved in a similar fashion as other equipment before 1990.

- NB: for real quantities of robots we simply use their counts as stocks.

References:

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