Robots, Firms, and Workforce Composition

Deng, Mueller, Plümpe & Stegmaier

Discussion by Simon Bunel *(Banque de France and PSE)*
CompNet ProdTalk - 10 May 2022

This paper: What it does

- Study the impact of robot adoption on employment composition at plant-level in Germany
- Build a task-based model as in Acemoglu and Restrepo (2018) to derive some theoretical predictions
- Exploit plant-level data to empirically test these predictions combining:
  - Robot use data
  - Employer-employee dataset (hiring, job separations, age and occupations)
- Event study design

This paper: What it finds

Theory - Task-based model:

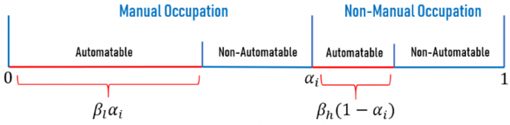


Figure 1: Automatable and Non-Automatable Tasks by Occupation

$$y_i = A_i \left(\underbrace{(\beta_\ell \alpha_i + \beta_h(1-\alpha_i))^{\frac{1}{\sigma}} (\lambda k_i)^{\frac{\sigma-1}{\sigma}}}_{\text{robots}} + \underbrace{((1-\beta_\ell)\alpha_i)^{\frac{1}{\sigma}} \ell_i^{\frac{\sigma-1}{\sigma}}}_{\ell\text{–labor}} + \underbrace{((1-\beta_h)(1-\alpha_i))^{\frac{1}{\sigma}} h_i^{\frac{\sigma-1}{\sigma}}}_{h\text{–labor}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

Empirics - Event-study design exploiting the timing of adoption of robots:

$$Y_{it} = \alpha_i + \sum_{t=-3}^{t=1} \beta_t \, T_t + \sum_{t=-3}^{t=1} \gamma_t \, Robot_i \, T_t + \epsilon_{it},$$

This paper: What it finds

Prediction 1: the employment effect is ambiguous and, if it is positive, it is accompanied with increased worker reallocation.

Empirical results:

- Positive effect on employment
- Positive effect on hiring and separations

	(1) Employment b/se	(2) Hirings b/se	(3) Separations b/se
2.rel_time	0.0056	-0.0780***	0.0298
	-0.0035	-0.0188	-0.0187
3.rel_time	0.0090*	-0.0501**	0.0521***
	-0.0048	-0.0197	-0.019
4.rel_time	0.0135**	-0.0129	0.0893***
	-0.0059	-0.02	-0.0195
5.rel_time	0.0072	-0.0295	0.1167***
	-0.008	-0.0212	-0.0201
1.D_robot_adoption#2.rel_time	0.0094	0.0574	0.0027
	-0.0101	-0.0715	-0.0621
1.D_robot_adoption#3.rel_time	0.0204	0.1002	0.0611
	-0.0152	-0.0763	-0.061
1.D_robot_adoption#4.rel_time	0.0494**	0.2697***	0.0549
	-0.0231	-0.0756	-0.0672
1.D_robot_adoption#5.rel_time	0.0580**	0.2029**	0.1213*
	-0.0279	-0.0796	-0.0703

This paper: What it finds

Prediction 2: Occupations performing less automatable tasks will experience the strongest gains in employment.

Empirical results:

- Statistically significant increases in the employment of technicians/engineers and managers.

Table 4: Effects by occupation and age (event study results)

	Occupation					Age		
	(1) simple manual b/se	(2) qual manual b/se	(3) techn/engin b/se	(4) manager b/se	(5) svc occ b/se	(6) young b/se	(7) midage b/se	(8) older b/se
2.rel_time	0.0152**	0.0017	0.0156***	0.0053	0.0029	-0.0138*	-0.0055	0.0505***
	(0.0069)	(0.0060)	(0.0060)	(0.0055)	(0.0065)	(0.0080)	(0.0049)	(0.0075)
3.rel_time	0.0187**	0.0049	0.0290***	0.0192***	0.0126	-0.0179*	-0.0149**	0.1005***
	(0.0095)	(0.0078)	(0.0077)	(0.0071)	(0.0087)	(0.0106)	(0.0066)	(0.0098)
4.rel_time	0.0315***	0.0051	0.0439***	0.0373***	0.0247**	-0.0264**	-0.0275***	0.1616***
	(0.0117)	(0.0096)	(0.0094)	(0.0088)	(0.0107)	(0.0126)	(0.0081)	(0.0117)
5.rel_time	0.0411***	-0.0130	0.0458***	0.0426***	0.0219*	-0.0515***	-0.0514***	0.2014***
	(0.0142)	(0.0122)	(0.0108)	(0.0105)	(0.0121)	(0.0147)	(0.0107)	(0.0132)
1.D_robot_adoption#2.rel_time	0.0068	0.0020	0.0216	0.0353	0.0161	0.0294	-0.0037	0.0459*
	(0.0215)	(0.0183)	(0.0197)	(0.0303)	(0.0203)	(0.0181)	(0.0130)	(0.0247)
1.D_robot_adoption#3.rel_time	0.0165	0.0461*	0.0066	0.0243	0.0213	0.0653**	0.0110	0.0346
	(0.0290)	(0.0278)	(0.0299)	(0.0359)	(0.0312)	(0.0277)	(0.0208)	(0.0259)
1.D_robot_adoption#4.rel_time	0.0097	0.0662	0.0669*	0.0740*	0.0715	0.1098***	0.0441	0.0196
	(0.0491)	(0.0445)	(0.0357)	(0.0412)	(0.0489)	(0.0338)	(0.0282)	(0.0370)
1.D_robot_adoption#5.rel_time	0.0225	0.0841	0.0841**	0.0990**	0.0887	0.1449***	0.0568*	0.0284
	(0.0578)	(0.0560)	(0.0389)	(0.0483)	(0.0542)	(0.0412)	(0.0334)	(0.0408)

This paper: What it finds

Prediction 3: The impact of robot adoption on employment in different age groups varies systematically with occupation.

Empirical results:

- Positive impact for younger workers in the firm.
- Effect more + for (i) simple manual tasks for young workers, (ii) technicians and engineers for middle aged workers and (iii) managers for older workers.

Table 4: Effects by occupation and age (event study results)

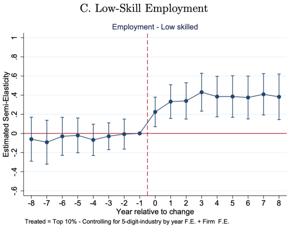
	Occupation					Age		
	(1) simple manual b/se	(2) qual manual b/se	(3) techn/engin b/se	(4) manager b/se	(5) svc occ b/se	(6) young b/se	(7) midage b/se	(8) older b/se
2.rel_time	0.0152**	0.0017	0.0156***	0.0053	0.0029	-0.0138*	-0.0055	0.0505***
	(0.0069)	(0.0060)	(0.0060)	(0.0055)	(0.0065)	(0.0080)	(0.0049)	(0.0075)
3.rel_time	0.0187**	0.0049	0.0290***	0.0192***	0.0126	-0.0179*	-0.0149**	0.1005***
	(0.0095)	(0.0078)	(0.0077)	(0.0071)	(0.0087)	(0.0106)	(0.0066)	(0.0098)
4.rel_time	0.0315***	0.0051	0.0439***	0.0373***	0.0247**	-0.0264**	-0.0275***	0.1616***
	(0.0117)	(0.0096)	(0.0094)	(0.0088)	(0.0107)	(0.0126)	(0.0081)	(0.0117)
5.rel_time	0.0411***	-0.0130	0.0458***	0.0426***	0.0219*	-0.0515***	-0.0514***	0.2014***
	(0.0142)	(0.0122)	(0.0108)	(0.0105)	(0.0121)	(0.0147)	(0.0107)	(0.0132)
1.D_robot_adoption#2.rel_time	0.0068	0.0020	0.0216	0.0353	0.0161	0.0294	-0.0037	0.0459*
	(0.0215)	(0.0183)	(0.0197)	(0.0303)	(0.0203)	(0.0181)	(0.0130)	(0.0247)
1.D_robot_adoption#3.rel_time	0.0165	0.0461*	0.0066	0.0243	0.0213	0.0653**	0.0110	0.0346
	(0.0290)	(0.0278)	(0.0299)	(0.0359)	(0.0312)	(0.0277)	(0.0208)	(0.0259)
1.D_robot_adoption#4.rel_time	0.0097	0.0662	0.0669*	0.0740*	0.0715	0.1098***	0.0441	0.0196
	(0.0491)	(0.0445)	(0.0357)	(0.0412)	(0.0489)	(0.0338)	(0.0282)	(0.0370)
1.D_robot_adoption#5.rel_time	0.0225	0.0841	0.0841**	0.0990**	0.0887	0.1449***	0.0568*	0.0284
	(0.0578)	(0.0560)	(0.0389)	(0.0483)	(0.0542)	(0.0412)	(0.0334)	(0.0408)

Main Comment

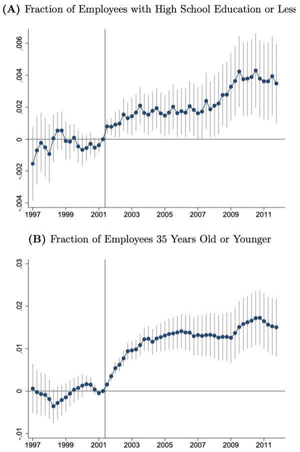
- Important paper on the impact of technical change on employment, at the intersection of several other contributions in the literature:
  - Demographic/occupational research question following Acemoglu and Restrepo (2022)
  - Using micro (plant) data (Aghion et al. (2022) among many others)
  - On robot use (Koch et al. 2021)
  - In the German context (Dauth et al., 2021)
- Very interesting dialogue between theory and empirics to derive some results about the impact of robots on workforce composition.

Main Comment

- Contributes to a new strand of the litterature on complementarity/substituability between labor and capital:



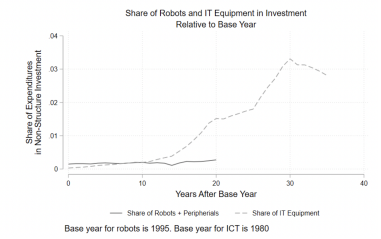
(a) Aghion et al. (2022)



(b) Curtis et al. (2022)

Comment: Is something special about robots?

- Advantage: identifies a specific and well-defined type of technology (ISO definition)
- Benmelech and Zator (2021):
  - Investment in robots accounts for less than 0.30% of aggregate expenditures on equipment
  - Recent increases in robotization do not resemble the explosive growth observed for IT technologies in the past.



- Consequence: Only 116 adopting firms in the sample
- What about a broader measure of modern manufacturing capital? (Aghion et al. 2022 / Curtis et al. 2022)

Comment: Endogeneity of robot adoption

- Could be interesting to have descriptive statistics about firm characteristics before adoption to understand what led them to adopt
- Pre-trends on "Young - simple manual tasks" or "Older - managers" could point in the direction of the existence of some counfounding factors or, even, reverse causality

Comment: Heterogeneity within occupation

- Would be interesting to study empirically the impact on the type of tasks performed within occupation
- Might have reallocation at the task level but not at the occupation level