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Productivity Effects of Knowledge Transfers through Labour Mobility

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6th FIW Research Conference

22.2.2013

Motivation

- Vital to understand productivity effects resulting from intensified labour mobility in the new economy
- 90ies and 00ies
  - Restructuring of industries with high and medium skilled people moving away from low tech to higher tech industries
  - **Essential question:**
    Are they able to make good use of their knowledge?

from / to	**Low tech**	**Medium tech**	**High tech**
Low tech	28.9%	4.3%	1.0%
Medium tech	3.6%	47.3%	1.9%
High tech	0.8%	2.0%	10.3%

Overview

- Knowledge acquision process
- Labour mobility
- Empirical model
- Data and descriptive statistics
- Results
- Robustness checks & counterfactual analysis

The knowledge acquisistion process (1/2)

- Assumption: productivity of an employee depends upon education and experience
- Working in a setting which provides access to valuable information increases the employee's human capital stock and thus their market value
  - On-the-job learning curve affected by the knowledge absorption capabilities (depending on education, personal characteristics)
  - Possibility to acquire knowledge greater in innovative areas

$$Prod_w = (h_0 * R_i)^{\beta_s}$$

The knowledge acquisistion process (2/2)

- When employees acquire additional information in the firm…
  - Employer faces the possibility of knowledge outflows as the employee might be tempted to join or set up a rival
  - Employer can only imperfectly protect knowledge (Cincera and van Pottelsberghe de la Potterie 2001)
    - Partly protected by patents
    - Partly "intellectual human capital"

Arrow (1962): "no amount of legal protection can make a thoroughly appropriable commodity of something as intangible as information"

Labour mobility (1/3)

- Two types of knowledge outflow when a higher skilled employee in a core area of the business decides to change employer
  - Outflow of firm-specific knowledge, which cannot be used by other firms (routines, organisational knowledge, …)
  - Outflow of more generally applicable knowledge and innovative ideas
    - Research intensive areas: labour mobility is a major knowledge diffusion channel (Intel)
    - State-of-the-art technologies are to a large extent tacit knowledge (Hoisl 2007; Winter 1987)

Labour mobility (2/3)

- The worker is more likely to switch to industries which are strongly linked to the one of the previous employer
  - Better usage of previously obtained knowledge
    => larger wage gains (Pack and Paxson, 1999; Moen, 2005)
  - Example: Knowledge acquired in the rubber and plastics industry may be of great value in the petroleum industry, but less applicable in the paper production industry

Labour mobility (3/3)

Average percentage of workers moving from industry i to j (1995-2005)

from \ to		15t16	17t19	20	21t22	23	24	25	26	27t28	29	30t33	34t35	36t37	D
15t16	Food , beverages and tobacco	9.80	0.22	0.08	0.21	0.02	0.42	0.19	0.14	0.32	0.32	0.38	0.19	0.12	12.41
17t19	Textiles, leather and footwear	0.17	3.99	0.03	0.12	0.00	0.08	0.15	0.05	0.21	0.19	0.17	0.12	0.21	5.47
20	Wood and of wood and cork	0.08	0.02	2.26	0.06	0.00	0.02	0.05	0.06	0.14	0.17	0.05	0.13	0.20	3.23
21t22	Pulp, paper,printing & publishing	0.20	0.07	0.09	9.27	0.02	0.17	0.14	0.10	0.19	0.26	0.24	0.22	0.18	11.15
23	Coke and refined petroleum	0.03	0.01	0.00	0.01	0.28	0.02	0.01	0.00	0.04	0.02	0.01	0.03	0.00	0.45
24	Chemicals and chemical products	0.35	0.11	0.03	0.15	0.05	4.53	0.20	0.05	0.15	0.23	0.16	0.08	0.09	6.15
25	Rubber and plastics	0.11	0.15	0.04	0.09	0.01	0.18	2.13	0.05	0.27	0.24	0.21	0.15	0.14	3.76
26	Other non-metallic mineral	0.14	0.05	0.12	0.04	0.00	0.06	0.12	2.20	0.24	0.18	0.12	0.10	0.04	3.42
27t28	Basic metals & fabricated metal	0.24	0.13	0.18	0.27	0.07	0.25	0.35	0.17	10.33	1.52	0.58	0.67	0.23	14.98
29	Machinery and equipment n.e.c.	0.29	0.11	0.07	0.32	0.04	0.21	0.17	0.11	1.80	9.10	0.69	0.54	0.18	13.62
30t33	Electrical and optical equipment	0.21	0.13	0.06	0.23	0.02	0.30	0.15	0.11	0.53	0.80	9.30	0.36	0.13	12.33
34t35	Transport equipment	0.14	0.05	0.06	0.06	0.00	0.15	0.18	0.03	0.56	0.68	0.41	5.69	0.17	8.18
36t37	Manufacturing nec; recycling	0.12	0.14	0.23	0.11	0.02	0.07	0.15	0.05	0.22	0.16	0.17	0.31	3.09	4.83
D		11.89	5.16	3.23	10.92	0.54	6.48	3.98	3.12	15.00	13.85	12.47	8.59	4.77	100.00

Included are 12 EU countries: Belgium, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden, United Kingdom

Estimation of knowledge flows

- Output decomposition

$$Y_i = A_i \, K_{i_N}^{\alpha} \, K_{i_{ICT}}^{\beta} \, L_i^{\gamma}$$

$$\tilde{L}_i = \left(\underbrace{m_{ih}{}^{\theta} * m_{im}{}^{\mu} * m_{il}{}^{\lambda}}_{\text{number of high, medium and low skilled workers}} * \underbrace{\left(\frac{\bar{h}_{ii0} * R_i * l_{ii}}{l_i} \right)^{\beta_s}}_{\text{human capital stock created within the industry (accounting for outflows)}} \underbrace{\left(\sum_{\substack{j=1 \\ j \neq i}}^{J} \frac{\bar{h}_{ji0} * R_j * l_{ji}}{l_j} \right)^{\beta_o}}_{\text{human capital stock transfered from another industry through labour mobility}} \right)^{\frac{1}{\gamma}}$$

Basic specification

$$log\ MFP_{ict} = \beta_s\ log\ H^s_{ict} + \beta_o\ log\ H^o_{ict} + \alpha_t + \alpha_c + \alpha_i + \varepsilon_{ict}$$

- H^S is the human capital stock created within the industry weighted by the share of people staying in the industry
- H^0 represents the sum of the received human capital stocks from other industries weighted by the respective labour movements.
- Fixed country, industry effects and time effects
- An industry can increase ist overall human capital stock by investing more in research or „importing“ more workers from research intensive industries

Data

- **EU Labour Force Survey** - Labour flows
  - Included only medium and high skilled workers
  - Excluded occupations “clerks”, “service workers and shop and market sales workers” and “elementary occupations”
- **EU Klems Database** – data on TFP levels
- **Anberd Database** – R&D investments
  - PPP adjusted
  - Gross fixed capital formation deflator used
- **WIOD Database** – input/output relations

⇒ Panel data from 1995-2005 for 12 European countries

Descriptive statistics by country

code	Country / Industry	Average MFP growth	Average R&D inv. growth	Rel. size in terms of R&D	Rel. size in terms of labour	Rel. size in terms of VA
BE	Belgium	1.21	3.60	3.60	2.49	2.80
CZ	Czech Republic	3.63	3.24	0.68	4.10	1.23
DE	Germany	1.79	5.56	40.91	28.91	26.62
DK	Denmark	-0.38	8.04	1.63	1.58	1.64
ES	Spain	-0.57	4.85	2.86	9.18	7.25
FI	Finland	2.39	9.41	2.87	1.51	1.88
FR	France	2.13	2.33	19.31	14.57	15.19
IE	Ireland	1.59	-0.99	0.49	0.97	2.38
IT	Italy	-0.78	-1.53	5.47	15.55	15.09
NL	Netherlands	1.71	3.69	4.29	3.32	5.69
SE	Sweden	1.93	2.91	6.05	2.49	3.20
UK	United Kingdom	1.31	0.84	11.82	15.33	17.04

Results

Innitial results

	(i) DOLS	(ii) DOLS	(iii) DOLS	(iv) DOLS
Own ind. HC stock	0.164***		0.166***	
	(0.020)		(0.020)	
Own ind. HC stock high tech		0.205***		0.227***
		(0.029)		(0.033)
Own ind. HC stock med tech		0.170***		0.172***
		(0.021)		(0.021)
Own ind. HC stock low tech		0.143***		0.127***
		(0.027)		(0.026)
Oth. ind. HC stock	0.023***	0.022***		
	(0.006)	(0.006)		
Oth. ind. HC stock high tech			0.012***	0.011**
			(0.005)	(0.005)
Oth. ind. HC stock med tech			0.020***	0.019***
			(0.006)	(0.006)
Oth.ind. HC stock low tech			-0.008	-0.008
			(0.007)	(0.007)
Country effects	yes	yes	yes	yes
Industry effects	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
R^2	0.726	0.732	0.729	0.739
Observations	741	741	741	741

Problems (1/3): Endogeneity of labour flows

- Workers move from one firm to another in expectation of...
  - a better matching of their abilities with the needs of the employer (Topel and Ward 1992)
  - higher wages
- In a competitive labour market, the price for a specific qualification profile and workload should be equal across industries
  - Recent heterogeneous firm literature: wage dispersion between firms within an industry rather than between industries (Davis and Haltiwanger 1991; Faggio et al. 2010; Helpman et al. 2012)
  - Industries with higher propensity to export

Problems (2/3): Endogeneity of labour flows

- Industries consisting largely of more productive exporters which are paying higher wages and thus attracting more workers would lead to an endogeneity bias
- Instrumental variables approach
  - 1st step: estimating labour flows from industry i to j in region r in country c at time t
  - This is done for workers with age a, education level e and occupation o
  - 2nd step: aggregation of labour mobility flows estimation of prod. effects

$$log\ Mob_{aeojicrt} = \beta_1\, log\ Lab_{jcrt-1} + \beta_2 log\ Lab_{icrt-1} + \sum_{a}^{A} \beta_{3a}\, age_a +$$

$$+ \sum_{e}^{E} \beta_{4e}\, isced_e + \sum_{o}^{O} \beta_{5i}\, isco_o + \alpha_{ct} + \alpha_{cr} + \alpha_{ji} + \varepsilon_{aeoijcrt}$$

Problems (3/3) Intermediates & Counterfactual analysis

- Productivity effects not only from labour mobility but also through spillovers from improved intermediate goods
  - control for them by weighting R&D stocks of supplying industries by share of intermediate inputs from the respective industry
- Counterfactual analysis
  - Previous assumption: knowledge is transmitted across industries foremost via the mobility of medium and high skilled workers
  - What happens if we estimate productivity effects with flows of lower skilled workers?
    => Productivity effects should be minor as they are not expected to transmit much state-of-the-art knowledge

IV & Robustness checks

	(v) IV & DOLS	(vi) IV & DOLS	(vii) IV & DOLS	(viii) DOLS	(ix) DOLS
Own ind. HC stock	0.155*** (0.023)				0.171*** (0.020)
Own ind. HC stock high tech		0.212*** (0.033)	0.239*** (0.032)	0.246*** (0.030)	
Own ind. HC stock med tech		0.157*** (0.024)	0.169*** (0.024)	0.183*** (0.022)	
Own ind. HC stock low tech		0.136*** (0.031)	0.129*** (0.032)	0.146*** (0.027)	
Oth. ind. HC stock	0.023*** (0.007)				
Oth. ind. HC stock low edu.					-0.015** (0.007)
Oth. ind. HC stock high tech		0.016*** (0.005)	0.019*** (0.005)	0.015*** (0.005)	
Oth. ind. HC stock med tech		0.017** (0.007)	0.019*** (0.007)	0.018*** (0.006)	
Oth.ind. HC stock low tech		-0.002 (0.008)	0.000 (0.007)	-0.006 (0.007)	
IO spillovers			0.312*** (0.049)	0.230*** (0.046)	
Country effects	yes	yes	yes	yes	yes
Industry effects	yes	yes	yes	yes	yes
Year effects	yes	yes	yes	yes	yes
R^2	0.737	0.749	0.764	0.743	0.725
Observations	571	571	571	741	741

Conclusions

- Knowledge spillovers differ significantly by technology segment
  - Workers from the medium and high technology segment create substantial positive productivity effects to other industries
  - Workers from low technology industries induce no significant spillovers => people moving away from the low tech sectors during the restructuring process in Europe could not transfer knowledge effectively
- The observed annual increase in the human capital stock of around 3.5% over ten years lead to…
  - an overall 0.8% increase in productivity through labour mobility (lower bound)
  - an overall 5.8% higher MFP through the industry's own human capital stock, increased through R&D (4.5% for low-tech, 6.1% for medium-tech and 8.1% for high-tech industries respectively)

Thank you