IAB

The impact of the regional environment on firms' innovation behaviour

Increasing Heterogeneity in the Workforce and its Impact

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Some introducing aspects on innovation

- One main driver of economic growth is innovation
- Some (successful) innovation is on the basis of a quick idea
- Most of innovation is due to R&D activities

- Cost of innovation needs to be covered - at least on average in the long-run
- Tobin's Q: Cost of innovation equals expected returns
- Tobin's Q is the departure of our research

Reasons to innovate

- Macro-economic models typically assume a research sector (Romer 1990)
- This is rather for convenience than for explaining reality (i.e. to prevent firms from internalizing gains of R&D)
- From a firm perspective, innovation/R&D effort takes place to
  - introduce new products to the market
  - improve product quality
  - process innovation to produce with lower cost
  - adopt technologies from others
- Each motive is discussed in theoretical literature and is in line with Tobin's Q (Baldwin et al. 2003; Grossman/Helpman 1995; Melitz 2003)

Tobin's Q: Cost of innovation

- Knowledge production function (Griliches 1979)
- Input is typically some human capital measure
- Human capital is costly
- Diverse workforce may increase productivity/efficiency and, thus, decrease cost of innovation
- Human capital spillover effects (Griliches 1979, Romer 1990)
  - From one region to another region
  - From the home region or another region to a firm
  - From one firm to another
- Positive spillover effects further reduce (own) R&D cost

Tobin's Q: Returns to innovation

- Firms sell their products and achieve revenues
- Assumption: Innovation comes first, then the production
- Revenues have to cover
  - Production costs
  - Cost of innovation, that occurred in the past
- Therefore revenues must be higher than pure production costs
- Thus, presence of fixed cost (called operating profit)
- The (discounted) operating profit covers research cost ('traditional investment decision')
- As a consequence: no perfect competition
- Models in a NEG-world: revenues depend on distribution of consumers' expenditures in space and have a mark-up on marginal cost

Tobins's Q in detail

- From a firm's perspective: innovation takes place when Tobin's Q is at least satisfied

$$1 \overset{\text{Tobin's Q}}{\leq} \frac{\text{Present Value}}{\text{Replacement Cost}} \tag{1}$$

- Dichotomizing Tobin's Q yields logit/probit specification
- Probability to innovate at firm level may be influenced by
    - Distribution of expenditures over regions
    - Distribution of firms over regions
    - Distribution of human capital over regions
    - Firm specific variables/determinants
- Models of Martin/Ottaviano (1999); Baldwin/Martin/Ottaviano (2001); Melitz/Ottaviano (2008)

Empirical specification

- We consider firms (resp. establishments) that operate in an specific industry in space
- Thus, we take
  - industry specific effects
  - spatially lagged X-Variables into account
- We ask whether regional characteristics explain the probability to innovate
- We ask whether heterogeneity of the workforce explains innovation incentives
- Endogeneity problem of firm characteristics: e.g. the employment of 'human capital' is endogenous. Even lagged values are most likely endogenous
- We use logistic regression with standard errors that are clustered on industry level

Data

- GENESIS regional data base (Federal Statistical Office)
- German Employment History (100%, IAB) aggregated at establishment level
- IAB Establishment Panel (1999-2009)
- LIAB
- Variable of interests: 'Did you innovate (in the last year) in one of the fields':
    - Product innovation
    - Product improvement
    - Process innovation
    - Adopt products
- Data set is an unbalanced panel (approx. 2-3 obs. per establishment)

Descriptives on innovation types

Year	Improve-ment %	Adoption %	Intro-duction %	Process innov. %	approx. No. obs[1] cases
2001	41.3	24.2	9.7		11,760
2004	38.2	18.6	7.2		11,532
2007	45.8	30.7	14.1	25.6	11,596
2008	42.2	25.1	9.8	20.1	11,407
2009	44.1	27.1	10.5	19.7	11,379
2010	40.8	25.1	9.9	18.5	11,438

[1] varies because of missing values

Regional characteristics and fixed effects

- Population and spatially weighted population*
  alt. Population density and its spatially weighted value*

- No. of firms within industry + spatial weighted value
- Prop. of human capital in industry excluding own est.
  + spatial W values
- Prop. of human capital in all other industries
  + spatial W values
- Dummy for East Germany

- Industry Fixed Effects
- Time Fixed Effects

* Almost insignificant; used therefore revenues

Establishment characteristics

- Revenues
- Proportion of human capital
- Dummy single company
- Dummy partnership comp.
- Dummy foreign owned
- Dummy young/old establ.
- State of the art of machinery
- Export proportion on revenues
- Proportion high skilled foreigners
- Diversity among high sk. foreigners
- Diversity of age (LIAB)
- Diversity of experience (LIAB)

Results: Regional characteristics

	Improvement	Adoption	Introduction	Process Innov.
$revenue_n$	0.267**	0.126**	0.127**	0.306**
$\ln(firms_{ir})$	0.084**	0.033	0.026	0.017
$W \ln(firms_{ir})$	0.001**	0.000	0.001**	0.000
$s_{H,\ n}$	0.299*	0.255**	0.684**	0.220^{+}
$s_{H,ir\ -n}$	0.097*	-0.041	0.104*	0.243
$W_s\ s_{H,ir}$	0.349	0.681	-0.418	0.485
$s_{H,-i\ r}$	-0.121	0.041	-0.380	-0.459
$W_s\ s_{H,-i\ r}$	-9.649**	-2.249	-3.618	-5.394^{+}
East DE	-0.220**	0.032	0.113	-0.502**
Constant	-1.100	-3.079**	-3.958**	-3.867*
Pseudo R2	0.180	0.073	0.128	0.187
log-likelihood	-15877	-14601	-7909	-6061
No. obs	28600	28613	28530	14069
No. industries	55	56	51	53

$^{+}$ p<0.1; ** p<.05; *** p<.01, Cluster robust s.e.

Results: Establishment characteristics

	Improvement	Adoption	Introduction	Process Innov.
Single est.	-0.120	-0.134**	-0.166**	-0.213**
Partnership est.	-0.200***	-0.221**	-0.069	-0.409***
Foreign owned	0.119	-0.103	0.063	-0.080
DIV_{age}	0.164	0.345**	0.720***	0.497*
$DIV_{experience}$	0.171**	0.248**	0.328**	-0.069
young est.	-0.209***	-0.261***	-0.156*	-0.216**
old est.	-0.348***	-0.399***	-0.344***	-0.333***
newest mach.	0.895***	1.006***	1.156	0.943
new mach.	0.672**	0.800**	0.871	0.492
moderate mach.	0.380	0.616*	0.690	0.177
rather old mach.	0.004	0.660**	0.330	-0.153
export proportion	0.012***	0.003**	0.008***	0.007***
$s_{H, n:foreigners}$	-0.310	-0.425**	-0.908**	-0.842**
$DIV_{H, n: foreigners}$	0.370***	-0.032	0.292**	0.308***

$^{+}$ p<0.1; ** p<.05; *** p<.01, Cluster robust s.e.; DIV..Fractionalisation index

Summary of first evidence

- Our approach considers incentives to innovate from a Tobin's Q-Perspective
- Regional characteristics play a role on firm's incentives to innovate. BUT this effect is very weak.
- Depending on the specification, the number of competitors seems to be more relevant and partly the proportion of human capital in the region and industry
- Establishment characteristics are most important to identify differences in probabilities to innovate (within industries)
- Diversity within highly skilled might increase efficiency of innovation
- However, this raises endogeneity issues that are not controlled/considered so far

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68.2 km

Distance in km

——— W0.1   ——— W0.5   ● ● ● W0.9