Jens Horbach
University of Applied Sciences Augsburg

Christian Rammer
Centre for European Economic Research

The Relationship between Labor Shortage and Innovation

Zweite Herbstakademie des
Verbundkollegs Ökonomie
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Introduction

- Demographic change tends to reduce labor supply in Germany (though partly compensated by immigration)

- Ongoing discussion on labor shortage in the German economy but scientific studies are rare

- Innovative firms may be especially affected by (skilled) labor shortage because they need more qualified personnel compared to other firms

- Hampering of innovation can reduce productivity increases and growth in wealth: Does labor shortage act as a barrier to innovation activities?

Unemployment Rates in Germany by Qualification Level

no qualification

total

vocational education

academic qualification

17,4

5,3

3,4

2,0
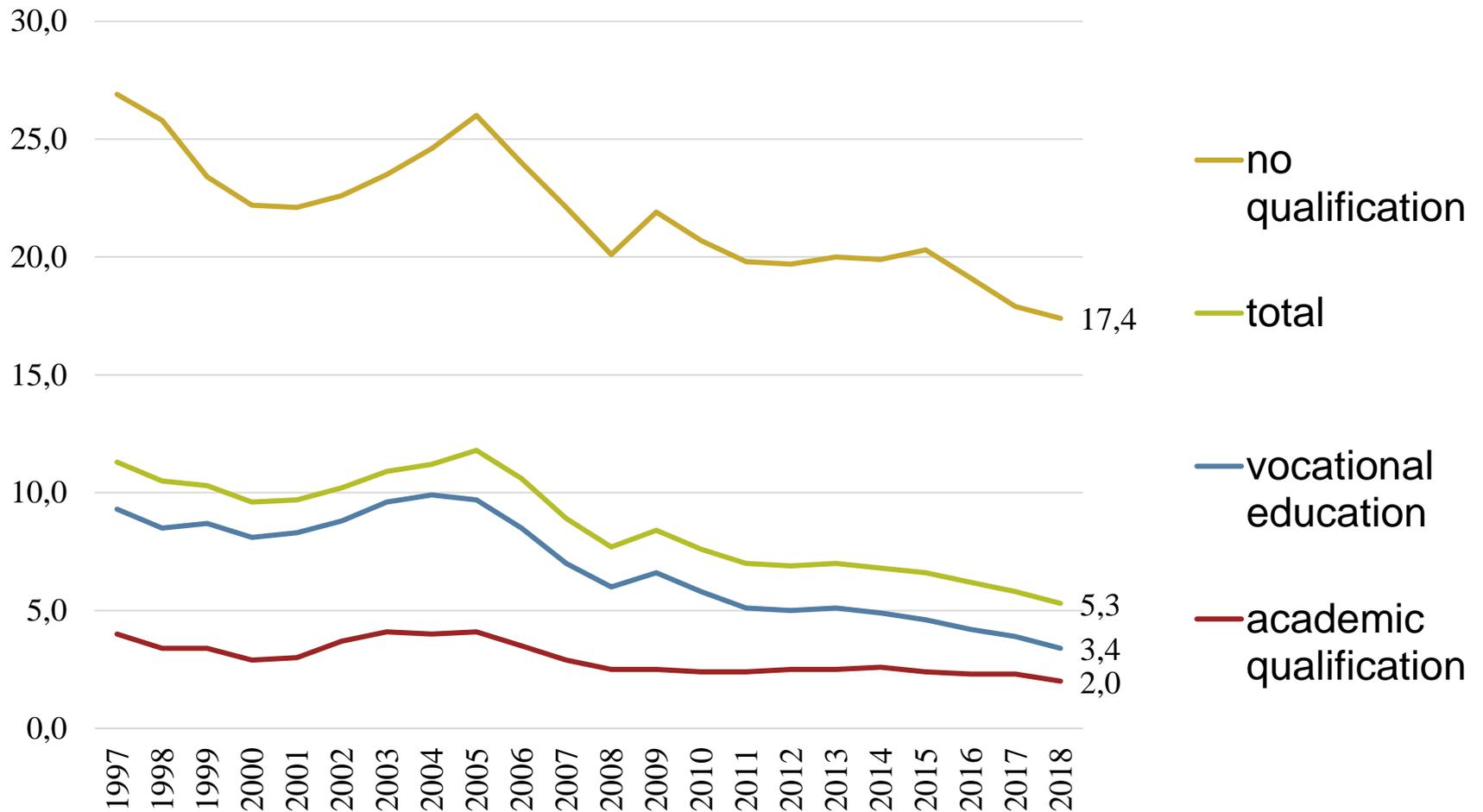
Source: IAB, qualifikationsspezifische Arbeitslosenquoten, 15.10.2019 (C. Röttger, B. Weber, E. Weber)

Structure

Theoretical background: Knowledge Production Function (KPF):

$$\Delta KP_i = f\ (R\&D_i,\ HC_i,\ IF_{ii},\ IF_{ij},\ X_i)$$

- Generation of new knowledge in a firm i (ΔKP_i) depends on R&D expenditure ($R\&D_i$) and on the availability of skilled human capital (HC_i).

- Information flows within the firm (IF_{ii}) and with other firms (IF_{ij}) e. g. via regional spill-over effects are also crucial.

- Furthermore, factors such as firm size, industry, international activities or the competition situation (X_i) are important for the production of new knowledge.

Definition and determinants of labor shortage

Definition

"A shortage occurs when the demand for workers for a particular occupation is greater than the supply of workers who are qualified, available and willing to work under existing market conditions"… "Over time, the market might adjust in a number of ways, including price and/or quantity adjustment, and the imbalance clears." (Shah and Burke 2003:v)

Determinants of shortage of (skilled) labor

Labor supply	Labor demand
- Demographic changes, - Lack of migration, regional immobility, - Reservation wages and willingness to participate in the labor market, - Over-qualification, - Family/work conflicts, - Too small public investment in education systems	- Shift of the labor demand curve - Innovation activities requiring new qualified personnel, - High product demand (business cycle), - High recruiting costs, - Qualification-related mismatch because of structural change, - Lack of further education measures - Home-made labor shortage: making no use of inexperienced graduates or elder personnel

Source: Summarized and complemented from Kettner (2012).

Measurement of labor shortage

- Vacancy rates in combination with unemployment (by sectors)

- Firm surveys (e. g. IAB establishment panel, MIP)

- Surveys of employees or unemployed persons to capture the labor supply side

Hypotheses:

H1   Innovative firms are more characterized by labor shortage because of their higher need and skill requirements

H2   A high product demand and a good profit situation is positively correlated to labor shortage

H3   A higher regional labor supply leads to less labor shortage in firms

H4   A lack of skilled labor restricts innovation activities

Data basis

- Mannheim Innovation Panel (MIP) 2018 matched with data of 2019, reference year 2017 for labor shortage, innovation data for 2015-2017 and 2016-2018

- Definition of labor shortage:
  Narrow definition: vacancies could not be filled at all

  Broad definition: incl. vacancies that could be filled only with delay or not with the desired skills

- Regional data at the NUTS 3 level (German districts)

Questions on Labour Shortage

8 Skill Demand

8.1 To what extent could your enterprise <u>fill job openings</u> during 2017? *(Multiple responses allowed!)*

Job openings

... could not be filled <u>at all</u> .... ☐$_1$ → To <u>how many jobs</u> did this apply? .... ca. ☐

... could be filled <u>only with delay</u> .... ☐$_1$

... could be filled, but not <u>with the desired personnel</u> .... ☐$_1$ } → To <u>how many jobs</u> did this apply? .... ca. ☐

... could be filled <u>as planned</u> .... ☐$_1$ → To <u>how many jobs</u> did this apply? .... ca. ☐

<u>No job offerings</u> during 2017... ☐$_1$ → *Please continue with Question 8.3!*

8.2 Which <u>level of qualification</u> was <u>required</u> for the open positions in 2017? *(Multiple responses allowed!)*

<u>Academic qualification</u>	<u>Vocational education</u>	<u>Semiskilled/unskilled</u> tasks
<u>Computer sciences</u>, maths, statistics .... ☐$_1$	<u>Manufacturing</u> professions . ☐$_1$	<u>Production</u> .... ☐$_1$
Other <u>science and engineering</u> .... ☐$_1$	<u>IT</u> professions .... ☐$_1$	<u>Logistics</u>/transportation .... ☐$_1$
<u>Others</u> (e.g. business, law) .... ☐$_1$	<u>Others</u> .... ☐$_1$	<u>Services</u> .... ☐$_1$

Labor shortage in German firms 2017

Labor shortage indicators	In % of all firms in the sample
Vacancies couldn´t be filled, late filling or filling with other than the desired personnel	38.4
Vacancies couldn´t be filled	19.8
Labor shortage in academic qualifications	17.1
Labor shortage in professional qualifications	27.3
Labor shortage in unskilled occupations	19.6

Estimation strategy

Endogeneity problem: Innovative firms may need more qualified personnel to realize innovations so that innovation activities may be accompanied by a higher degree of labor shortage. On the other side, a lack of skilled labor may reduce a firms´ ability and capacity to innovate.

We estimate an instrumental variable probit regression of y_i on exogenous covariates x_i and c (c = 1,2) endogenous variables. The vector $\mathbf{z}_{ci}$ contains the variables from $\mathbf{x}_i$ and other covariates affecting $\mathbf{w}_{ci}$ but that are not correlated to y_i.

$$y_i = \mathbf{x}_i \mathbf{\beta} + \mathbf{w}_{ci}\mathbf{\beta}_c + \varepsilon_i$$

$$w_{ci} = \mathbf{z}_{ci}\mathbf{\gamma}_c + \mathbf{\varepsilon}_{ci}$$

Determinants of labor shortage in German firms

Correlates	Dependent variables		
	Labourshortbroad	*Labourshortnarrow*	*Qualcount*
Agefirm	-0.005 (-1.29)	-0.005 (-1.73)+	-0.01 (-1.37)
Demand	0.11 (2.54)**	0.00 (1.45)	0.32 (2.75)**
Empdynamic	0.40 (2.95)**	0.004 (0.04)	0.54 (1.04)
EastGermany	0.02 (1.99)*	0.03 (2.43)**	0.03 (0.39)
Innobreadth	-	-	0.16 (2.60)**
Innovation	0.45 (7.73)**	0.27 (3.23)**	-
Newcomp	-0.03 (-1.55)	-0.04 (-2.23)*	-0.08 (-1.65)+
Pathdep	0.15 (4.28)**	0.10 (3.94)**	0.25 (4.13)**
Popdensity	0.01 (1.79)+	0.01 (1.66)+	0.03 (1.50)
Pricecomp	0.06 (2.80)**	0.04 (2.29)*	0.13 (2.35)*
Credrating	0.08 (1.98)*	0.05 (1.51)	0.24 (2.48)**
Shareacad	-0.14 (-5.81)**	-0.05 (-2.81)**	-0.53 (-2.83)**
Size	0.09 (0.16)	-0.03 (-0.03)	0.002 (0.71)
Substitutability	0.02 (1.00)	0.006 (0.54)	0.08 (1.43)
Unemprate	-0.62 (-1.19)	-0.75 (-1.88)+	-1.10 (-1.05)
# observations	2,816	2,816	2,816
Wald Chi^2	446.5	144.9	

Probit model (*Labourshortbroad* and *Labourshortnarrow*) and poisson model (*Qualcount*) with endogenous covariate. The endogenous variables *Innovation* and *Innobreadth* are instrumented. Instruments for these variables: *Compabroad, Dedomainpc.* Robust and clustered standard errors. Instead of coefficients, average marginal effects are reported. Concerning dummy variables, the values report changes in probability for discrete changes of dummy variables from 0 to 1. Z-statistics are given in parentheses. +, *, and ** denote significance at the 10%, 5%, and 1% levels, respectively. Sector dummies and constants are included but not reported.

Results

- Innovative firms are more likely to be characterized by skilled labor shortage

- Path dependency of labor shortage

- Good performing firms characterized by a high demand and a good profit situation are more likely to have labor shortage

- Firms showing a high share of academic staff are less affected by labor shortage problems

- The main results also hold if a narrow definition of labor shortage is applied

Innovation failure 2017 and labor shortage in Germany

Correlates	Dependent variable: *Innovationfail2017*				
	Labour shortage in general	Skilled labour shortage	Academic labour shortage	Vocational labour shortage	Unskilled labour shortage
Labour shortage					
Labourshortbroad	0.15 (2.68)**	-	-	-	-
SkilledLS	-	0.12 (2.29)*	-	-	-
AcademicLS	-	-	0.06 (1.39)	-	-
VocationalLS	-	-	-	0.14 (1.95)*	-
UnskilledLS	-	-	-	-	0.10 (0.88)
Control variables					
Agefirm	-0.00 (0.17)	-0.00 (0.17)	-0.00 (-0.11)	-0.00 (0.22)	0.00 (0.01)
EastGermany	-0.01 (-2.04)*	-0.01 (-1.84)	-0.02 (-2.03)*	-0.02 (-1.67)	-0.02 (-1.81)+
Empdynamic	-0.03 (-1.27)	-0.04 (-1.19)	-0.04 (-0.79)	-0.04 (-1.28)	-0.04 (-1.06)
Innobreadth	0.02 (2.30)*	0.02 (2.29)*	0.02 (2.08)*	0.02 (2.52)**	0.02 (2.87)**
Credrating	-0.02 (-2.35)*	-0.02 (-2.42)*	-0.02 (-2.04)*	-0.02 (-2.38)*	-0.01 (-1.77)+
Size	0.03 (4.09)**	0.03 (4.16)**	0.03 (4.09)**	0.03 (4.03)**	0.03 (3.79)**
# observations	3,519	3,519	3,519	3,519	3,515
Wald Chi^2	221.1	193.3	167.3	212.5	195.9

Probit model with endogenous covariates. The endogenous variables *Innobreadth, Labourshortbroad, AcademicLS, SkilledLS, VocationaLS* and *UnskilledLS* are instrumented. Instruments for *Innobreadth*: *Dedomainpc, Shareacad.* Instruments for *Labourshort, AcademicLS, SkilledLS, VocationalLS*: *Shortlifecycle, GDPemp.* Instrument for *UnskilledLS: Substitutability.* Robust and clustered standard errors. Instead of coefficients, average marginal effects are reported. Concerning dummy variables, the values report changes in probability for discrete changes of dummy variables from 0 to 1. Z-statistics are given in parentheses. +, *, and ** denote significance at the 10%, 5%, and 1% levels, respectively. Sector dummies and constants are included but not reported.

Results:

- Labor shortage induces innovation failure measured by the cancelation of innovation projects.

- This result is significant for vocational training (production and information technologies) but not for labor shortage of academics and non-skilled workers.

- Not surprisingly, innovative firms are more likely for innovation failures

- A bad profit situation is correlated to more innovation failures

Thank you for your attention!