Agglomeration of Knowledge: A Regional Economic Analysis for the German Economy

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Overview

Motivation

- The aim is to investigate: 1. to what extent is knowledge in different job-related areas rewarded in the German labor market (calculate the wage premium due to job-specific knowledge) 2. where the knowledge-specific labor force is agglomerated in the German economy 3. what are the related effects both on the micro- and on the macro-level (regional growth) $\Rightarrow$ find effects of knowledge and diversity in high-knowledge employment for regional growth
- Patterns of geographical localization of employment give evidence for differences in the dissemination of knowledge across peers and customers

Motivation

- Lucas (1988): "the benefits of colleagues from whom we hope to learn are tangible enough to lead us to spend a considerable fraction of our time fighting over who they might be, and another fraction traveling to talk with those we wish we could have as colleagues but cannot..."

Literature Review

- Geographical concentration of economic activity (Krugman 1991, Rosenthal and Strange 2001, Ellison and Glaeser 1997, 2010) $\Rightarrow$ considers the production side
- Occupational side: which areas of skills and knowledge are driving the geographical concentration of workers (Gabe 2009, Abel and Gabe 2011, Gabe and Abel 2011)
- Relatively unexplored which are the specific knowledge areas that are driving economic development (Gabe 2009, Powell and Snellman 2004) $\Rightarrow$ due to problems arising from the measurement of knowledge (Howells 2002) $\Rightarrow$ education imprecise measure for human capital

Literature Review

- US labor market: knowledge and skills in law and government, medicine and dentistry, engineering and technology, production and processing are most rewarded whereas knowledge in chemistry, physics and biology, food production, personnel and human resources is not rewarded (Gabe 2009)
- Producer service knowledge (which comprises the areas of administration and management, economics and accounting, customer and personal service, clerical, law and government) and knowledge in information technology (computers and electronics) are conducive for regional growth (Abel and Gabe 2011, Florida et al. 2008)

Literature Review

- Abel and Gabe (2011) find that a one percent increase in the regional share of college degree holders is associated with a two percent increase in regional GDP per capita
- German labor market: a larger growth of technological employees and bohemians has been shown to be conducive for regional employment growth (Wedemeier 2009); technological diversity is promoting productivity growth but not employment growth

Theoretical Background

- Positive effects resulting from knowledge and human capital accumulation for economic development and growth (Lucas 1988, Romer 1986)
- Human capital promotes individuals' productivity and generation of ideas (Becker 1964)
- Especially the creative professions are conducive for economic growth (Lucas 1988, Florida 2002)
- Highly educated people in a society enhance the productivity of others (Lucas 1988, Rauch 1993, Moretti 2004)

Theoretical Background

- Agglomeration or geographical proximity to other people enhances the mutual exchange of ideas and knowledge (Glaeser et al. 1992)
- Diversity of employees fosters the flow of different ideas and knowledge (Jacobs 1969, Florida 2002)
- Spillovers are increasing technological progress, causing innovations, and are thus conducive to economic growth (Rauch 1993, Howells 2002)
- Relation contrasted by views of Marshall (1890) which is that specialization is leading to better access of inputs, labor and knowledge spillovers

Theoretical Background

- Building a bridge between these contrasting views, Duranton and Puga (2001) developed a model that attributes the production of new items to diversified cities: the producers over time learn how to produce in masses and then production switches over to specialized cities

Theoretical Background

- Jobs where tacit knowledge is required $\Rightarrow$ proximity to peers (face-to-face contact) becomes important (Polanyi 1966, Howells 2002, Lever 2002, Storper and Venables 2004) $\Rightarrow$ workers benefit from closer communication with each other, face fewer incentive and coordination problems, bear lower screening costs for potential new partners and can derive a higher degree of motivation (Storper and Venables 2004)
- Borowiecki (2013): classical composers benefitted from the clustering and quality of their peers: their productivity in terms of written musical works per years significantly increased when other classical composers of high quality were close (Beethoven, Mozart...)

Theoretical Background

- Agglomeration, however, does not only invoke positive externalities: Workers benefitting from collaboration will benefit from clustering together whereas other workers might suffer from a higher degree of competition (Howells 2002, Lever 2002)

Empirics

- Examining: first, construct a measure for high-knowledge second, measure the effects of knowledge on labor earnings through a Heckman selection estimation procedure third, investigate the geographical localization of high-knowledge employment across the German regional planning units fourth, investigate the effects of agglomerated high-knowledge employment and the diversity on regional growth

Empirics

Table : Occupational knowledge

Administration and management	Psychology
Clerical	Sociology and anthropology
Economics and accounting	Geography
Sales and marketing	Medicine and dentistry
Customer and personal service	Therapy and counseling
Personnel and human resources	Education and training
Production and processing	English language
Food production	Foreign language
Computers and electronics	Fine arts
Engineering and technology	History and archaeology
Design	Philosophy and theology
Building and construction	Public safety and security
Mechanical	Law, government and jurisprudence
Mathematics	Telecommunications
Physics	Communications and media
Chemistry	Transportation
Biology	

Source: US Department of Labor, ONET system.

Empirics

- Take importance and level of knowledge: scale measuring the importance of knowledge ranges from 1 to 5, and the scale measuring the level of knowledge ranges from 1 to 7, higher values indicating a higher degree of the level or importance of knowledge
- Match the ONET job classification (974 different occupations) with the DIW SOEP variable: $E1110506$, for the year 2006, Occupation of Individual, comprising 296 different occupations

Empirics

- Assume that the categorization of knowledge requirements for different jobs as given by the US Statistics is transferable to the German occupations
- Calculate a knowledge index by multiplying the level of knowledge score with the importance of knowledge score (Feser (2003) or Gabe and Abel (2011))
- We defined high-knowledge requirements covering the occupations that score an index value of at least 60 percent of the score of the occupation with the highest value of the knowledge index

Empirics

Table : Importance of knowledge for Economists

Element name	Data value
Administration and Management	2.58
Clerical	1.83
Economics and Accounting	4.71
Sales and Marketing	1.88
Customer and Personal Service	2.25
Personnel and Human Resources	1.96
Production and Processing	1.92
Food Production	1.17
Computers and Electronics	3.12
Engineering and Technology	1.42
Design	1.29
Building and Construction	1.38
Mechanical	1.38
Mathematics	4.58

Empirics

Table : Importance of knowledge for Economists–continued

Physics	1.43
Chemistry	1.38
Biology	1.38
Psychology	2.42
Sociology and Anthropology	2.54
Geography	2.35
Medicine and Dentistry	1.33
Therapy and Counseling	1.46
Education and Training	3.08
English Language	3.83
Foreign Language	1.57
Fine Arts	1.29
History and Archeology	2.29
Philosophy and Theology	1.96
Public Safety and Security	1.35
Law and Government	2.88
Telecommunications	1.71
Communications and Media	2.29
Transportation	1.79

Source: US Department of Labor, ONET system.

Empirics

Table : Importance of knowledge for Morticians, Undertakers, and Funeral Directors

Element name	Data value
Administration and Management	3.92
Clerical	3.86
Economics and Accounting	3.58
Sales and Marketing	3.26
Customer and Personal Service	4.98
Personnel and Human Resources	3.15
Production and Processing	2.23
Food Production	1.08
Computers and Electronics	3.14
Engineering and Technology	1.55
Design	1.44
Building and Construction	1.49
Mechanical	1.82
Mathematics	2.96

Empirics

Table : Importance of knowledge for Morticians, Undertakers, and Funeral Directors–continued

Physics	1.84
Chemistry	3.81
Biology	3.30
Psychology	3.70
Sociology and Anthropology	2.63
Geography	1.95
Medicine and Dentistry	2.29
Therapy and Counseling	3.24
Education and Training	3.50
English Language	4.19
Foreign Language	1.93
Fine Arts	1.55
History and Archeology	1.87
Philosophy and Theology	3.20
Public Safety and Security	3.13
Law and Government	3.60
Telecommunications	2.43
Communications and Media	2.77
Transportation	3.58

Source: US Department of Labor, ONET system.

Empirics

Quick Search for: religious professional

Occupations matching "religious professional"

The search results are listed in a rank order that is calculated on the relevance of the occupational title, alternate titles, description, tasks, and detailed work activities associated with the keyword you entered.
Select the **Relevance Score** to view the specific items matched by your search within the occupation.

Relevance Score	Code	Occupation
100	21-2021.00	Directors, Religious Activities and Education
80	21-2099.00	Religious Workers, All Other
39	25-1126.00	Philosophy and Religion Teachers, Postsecondary
36	21-2011.00	Clergy
36	51-3023.00	Slaughterers and Meat Packers
35	25-1062.00	Area, Ethnic, and Cultural Studies Teachers, Postsecondary
32	41-4012.00	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products Bright Outlook
17	19-3041.00	Sociologists

Empirics

Table : Occupations with high-knowledge in the branch of Administration and Management

Director, Chief Executive	Corporate Manager
General Manager Business Services	General Manager
Prod, Ops, Manager Business Services	Advertising, Pblc, Relatns, Dept, Mng
Sales, Marketing Department Manager	Computer Services Department Manager
Financial, Administration Dept, Manag	Prod, Ops, Manager Manufacturing
General Manager Manufacturing	Prod, Ops, Mngr, Trnspt, Strge, Com
General Mngr, Trnsprt, Storage, Coms	Personnel, Ind, Relations Dept, Manag
Gen, Mngr, Agri, Hunt, Frstry, Fis	General Manager Construction
General Manager Restaurants, Hotels	Prod, Ops, Mngr, Restaurants, Hotel
Prod, Ops, Department Manager NEC	Other Department Manager NEC
General Manager NEC	Supply, Distribution Department Manag
General Manager Wholesale, Retail Tra	Business Professional NEC
Architect, Town, Traffic Planner	Sr, Official Organisation
Sr, Official Political Party Org	Sr, Official Employer, Worker Org

Source: US Department of Labor, ONET system.

Empirics

Econometric specification:

$$ln(earnings)_i = \beta_0 + \beta_{1i} * educ_i + \beta_{2i} * age_i + \beta_{3i} * age_i^2 + \beta_{4i} * X_i + \beta_{5i} * Z_i + \epsilon_i \quad (1)$$

ln(earnings): natural logarithm of monthly individual labor earnings
educ: variable indicating whether the individual has received the A-levels
X: a set of variables capturing individual characteristics (married, immigrant, male, job status)
age: to capture labor market experience
age^2
Z: a vector of high-knowledge indicators
around 65 percent work full-time, people between age 18 and 65
difference of other household income to individual income as exclusion restriction in the selection equation

Empirics

Table : The effect of knowledge on earnings

VARIABLES	Selection equation (Probit) full-time working	ln(individual labor earnings)
Constant	-4.604***	7.484***
Education	0.0309***	0.0338***
Age	0.120***	0.0587***
Age^2	-0.00128***	-0.000550***
Male	1.204***	0.360***
Immigrant	-0.0603	0.0616***
Married	-0.191***	0.0798***
Blue-collar worker	1.581***	0.400***
Clerk	1.844***	0.672***
Civil servant	2.015***	0.679***
Self-employed	1.757***	0.488***

Empirics

Table : The effect of knowledge on earnings–continued

Administration and management	0.157***
Clerical	0.141***
Economics and accounting	0.0697*
Sales and marketing	0.282***
Customer and personal service	-0.0120
Personnel and human resources	0.194***
Production and processing	0.119***
Food production	-0.377
Computers and electronics	0.224***
Engineering and technology	-0.0116
Design	-0.0421
Building and construction	0.0152

Empirics

Table : The effect of knowledge on earnings–continued

Mechanical	0.150***
Mathematics	0.261***
Physics	-0.00305
Chemistry	0.0828
Biology	0.349***
Psychology	-0.0994*
Sociology and anthropology	-0.232
Geography	-0.0640
Medicine and dentistry	0.171***
Therapy and counseling	0.159***
Education and training	-0.00594
Language	0.0687***

Empirics

Table : The effect of knowledge on earnings–continued

Foreign language	-0.130
Fine arts	-0.0240
History and archeology	0.0431
Philosophy and theology	0.0913**
Public safety and security	-0.102**
Law and government	0.217***
Telecommunications	-0.230
Communication and media	0.133
Transportation	-0.0213
Difference household to individual income (in selection equation)	-4.59e-06***
Lambda	0.0588
Observations	11049

Source: US Department of Labor, O*NET system and German SOEP data. Notes: This table displays results from a Heckman two-step selection regression for individual labor earnings with a Probit regression for selection into full-time employment. *** denotes significance at a 1 percent level, **denotes significance at a 5 percent level, * denotes significance at a 10 percent level. The mills ratio (lambda) indicates that selection is not important in this regression. Standard errors are shown in the parentheses.

Empirics

Investigate the geographical localization of employment in different jobs with high-knowledge requirements
Take 96 so called Raumordnungsregionen, the urban districts and counties
Consider only those individuals who had their workplace at their place of residence and those who lived in a commuting distance to the workplace of up to 20 kilometers
Specialization measured as:

$$KI_k = \sum_{r=1}^{R} \left| \frac{e_{k,r}}{e_r} - \frac{1}{K-1} \sum_{k=1}^{K} \frac{e_{k,r}}{e_r} \right| \tag{2}$$

Empirics

Table : Agglomeration of employment in high-knowledge activities

Knowledge areas	Krugman index	Knowledge areas	Krugman index
Communication and media	1.3907	Law and government	0.5577
Physics	1.1649	Computers and electronics	0.5501
Fine arts	1.0499	Mechanical	0.5462
Chemistry	1.0352	Sales and marketing	0.5242
Geography	0.9906	Design	0.4958
Transportation	0.881	Administration and management	0.4915
Public safety and security	0.8678	Psychology	0.4836
Biology	0.7387	Mathematics	0.4692
Building and construction	0.709	Education and training	0.4598
Personnel and human resources	0.6697	Production and processing	0.4532
Economics and accounting	0.6535	Philosophy and theology	0.4392
Therapy and counseling	0.5944	Clerical	0.3502
Engineering and technology	0.581	Customer and personal service	0.3284
Medicine and dentistry	0.563	Language	0.287

Source: US Department of Labor, O*NET system and German SOEP data. Notes: This table displays Krugman concentration indices for employment in different jobs with high-knowledge requirements. We do not show results for food production, sociology and anthropology, foreign language, history and archeology and telecommunications, since the number of employees in the sample was small.

Empirics

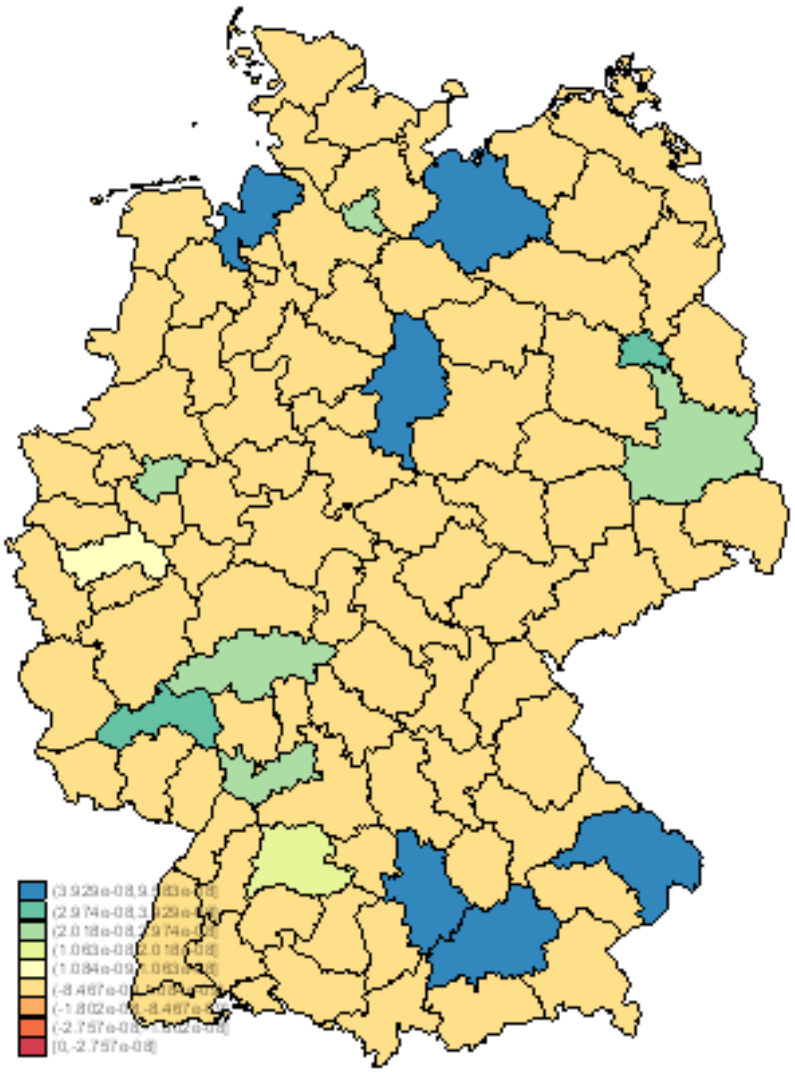
Map the Balassa index which is measured as:

$$B_r = \frac{e_{k,r}}{e_r} / \frac{e_k}{E} \tag{3}$$

Geographical coordinates are taken from the institute for construction, urban and spatial research (Bundesinstitut fuer Bau-, Stadt- und Raumforschung)

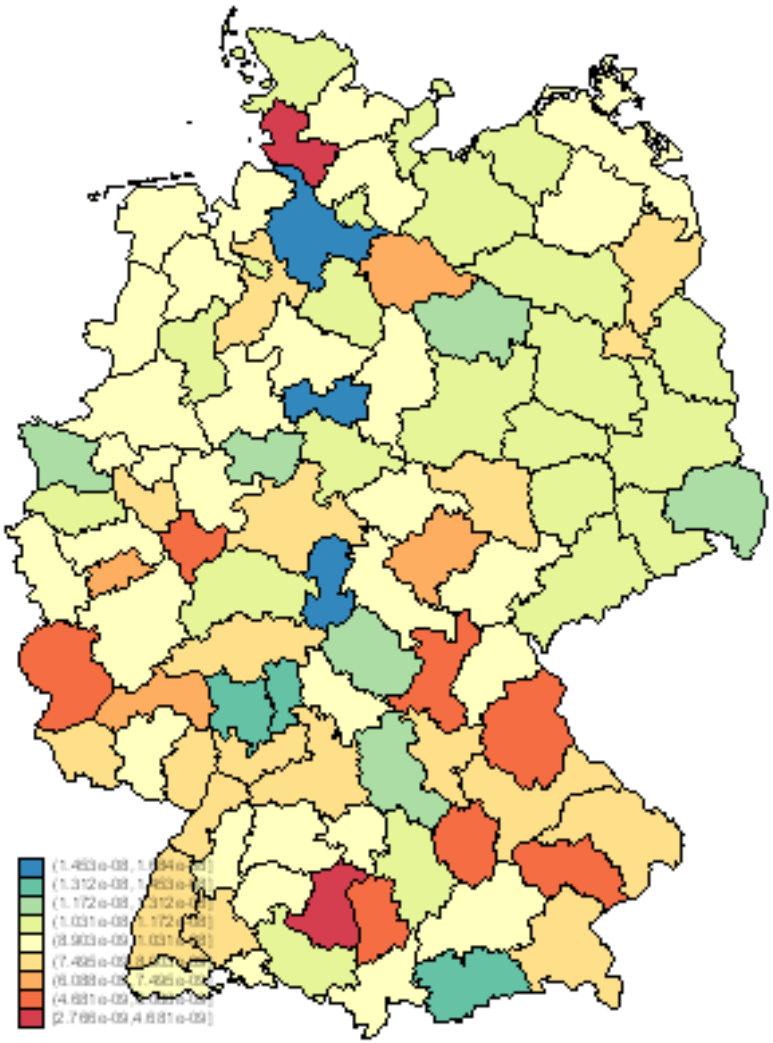
Empirics

Communications and media



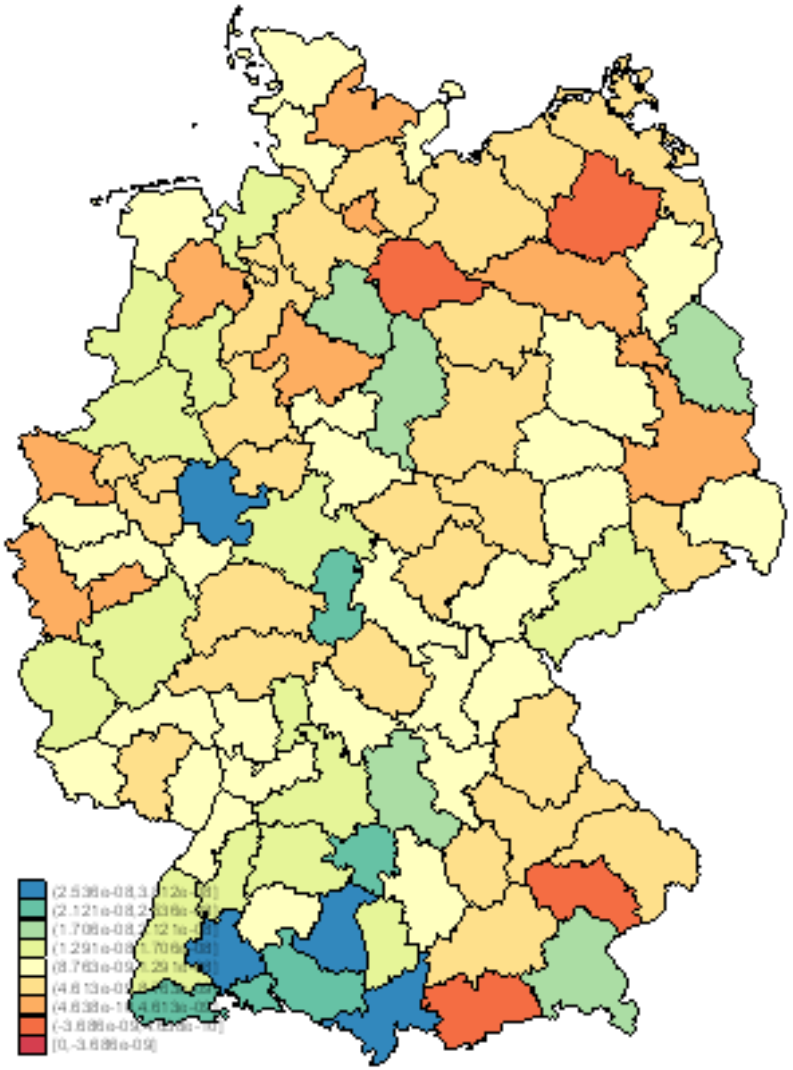
Empirics

Customer and personal service



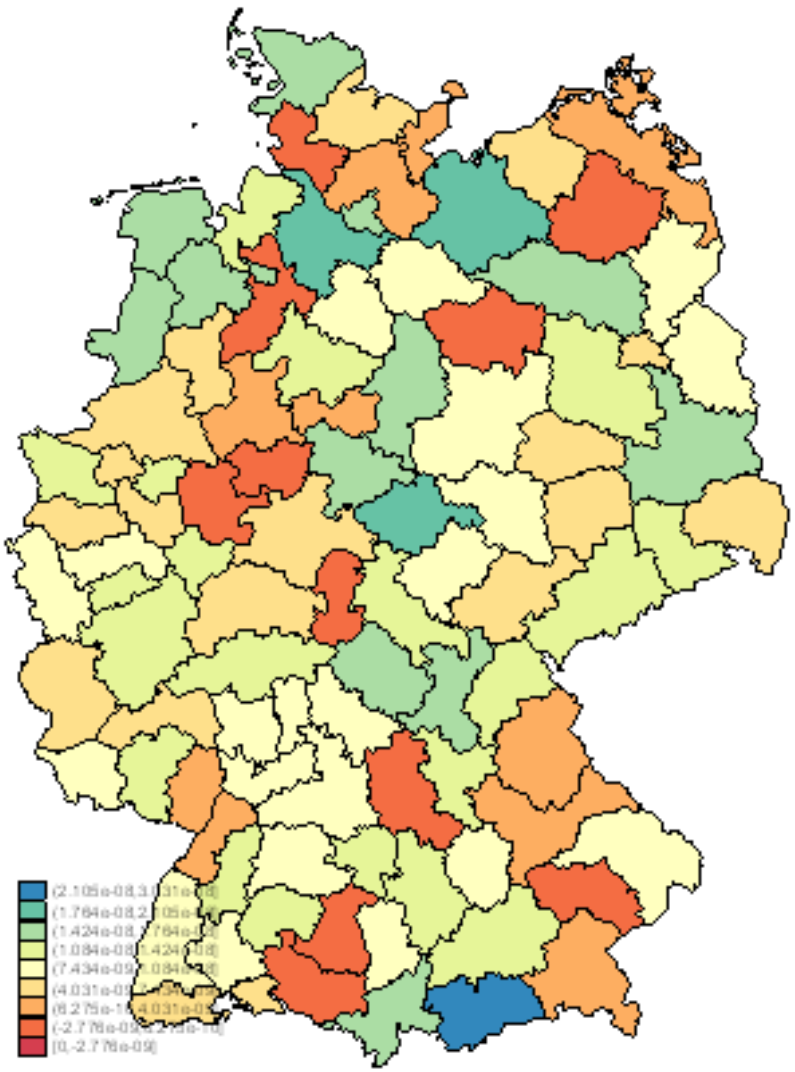
Empirics

Mechanical tasks



Empirics

Administration and Management



Empirics

Estimate the effect of diversity (fewer specialization) of high-knowledge employment for regional growth (referring to Jacobs 1969)
Diversity measured as

$$DV_r = 1 - \sum_{k=1}^{K} s_{r,k}^2 \tag{4}$$

Estimate a growth equation:

$$GDPcapGR_r = \beta_0 + \beta_{r,1} * popGR_r + \beta_{r,2} * DV_r + \beta_{r,3} * GDPcapini_r + \epsilon_r \tag{5}$$

Conclusions

- High-knowledge in sales and marketing, computers and electronics, mathematics, biology and law and government generates a positive wage premium for workers in the German economy
- High-knowledge in food production, design, building and construction, chemistry, psychology, sociology and anthropology, geography, foreign language, public safety and security, telecommunications, communication and media, and transportation appears not to be specifically rewarded or even be penalized in the German labor market

Conclusions

- The effects for earnings due to high-knowledge in the areas of clerical tasks, personal and human resources, mechanical tasks, biology, philosophy and theology are positive which contrasts recent results for the US (Gabe 2009)
- Workers in jobs with high-knowledge requirements which generate positive wage premiums like mechanical tasks or administration and development are more dispersed across regions $\Rightarrow$ proximity to customers