The Ruhr as a Knowledge Metropolis: Potential and Challenges

Matthias Kiese
Institute of Geography • Urban and Regional Economics

The Ruhr

• At 5.1 million inhabitants (06/2017), the Ruhr is Germany’s largest metropolitan area, comprising 6.2% of the national population.
• Polycentric structure with 53 municipalities
• Former manufacturing heartland with legacy of coal mining and steel industry

Figures: RVR 2018

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Key Questions

Can an old industrialised region be transformed into a knowledge metropolis?

• What is the knowledge metropolis?
• To what extent is the Ruhr a knowledge metropolis?
• What is the potential to build on?
• What challenges need to be solved?

Outline

1) The Knowledge Metropolis
2) Knowledge Infrastructure in the Ruhr
3) Knowledge Economy in the Ruhr
4) Conclusion and Outlook
Key Points of Departure

- The production, dissemination and use of knowledge is a social phenomenon that requires the interaction of actors in the distributed knowledge base (cf. Hayek 1946, Smith 2002).

- The density of actors in metropolitan areas provides more opportunities for knowledge to be generated, exchanged and applied:
  - Agglomeration/urbanisation economies (Marshall 1920, Jacobs 1969)
  - (Localized) knowledge spillovers (Audretsch/Feldman 1996)

- Spatial proximity facilitates the exchange of tacit knowledge (Polanyi 1966) that is difficult to communicate across distances:
  - Sticky information (Hippel 1994)

⇒ Cities as nodes/hubs of
  - Knowledge societies (Stehr 1994) = social, cultural, political dimensions
  - Knowledge(-based) economies (OECD 1996), learning economy (Lundvall/Johnson 1994)

⇒ KBE ⇒ re-urbanisation in Germany (cf. Siedentop 2008, Gornig/Mundelius 2012, Gans 2015)

What is the Knowledge Metropolis?

- A knowledge metropolis is an urban agglomeration whose social and economic development is driven by its capacity to generate, absorb, apply (utilise) and/or disseminate knowledge.

<table>
<thead>
<tr>
<th>Creation</th>
<th>Acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>producing ideas*</td>
<td>using ideas*</td>
</tr>
</tbody>
</table>

Application
Diffusion
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Forms of Knowledge

Knowledge

explicit

Know-what

information

explicit

Know-why

abilities, skills

explicit

Know-how

relations, networks

explicit

Know-who

Based on Polanyi 1966 and Lundvall/Johnson 1994, p. 27 ff.

The Knowledge Metropolis: Sub-Systems

Knowledge Society

Knowledge Economy

Technology Transfer
Incl. academic entrepreneurship (Spin-offs)
Transfer Infrastructure

Primary/Sec. Schools

Knowledge Infrastructure

Universities

Research Organisations

Own draft
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What is the Knowledge-based Economy (KBE)?

Knowledge-based economies are “directly based on the production, distribution and use of knowledge” (OECD 1996, p. 7).

Characteristics of the KBE (cf. Smith 2002)

• Knowledge as a factor of production (input)
• Knowledge as a product (output)
  • high-tech industries
  • knowledge-intensive business services (KIBS)
• R&D-intensive manufacturing industries by share of turnover spent on internal R&D
  • High technology (Hochtechnologie)
    • R&D intensity: 3%-9%
    • Chemical industry, mechanical engineering, electrical equipment, automotive industry, other vehicles
  • Cutting-edge technology (Spitzentechnologie): R&D intensity > 9%
    • Pharmaceutical industry, IT hardware, communications engineering, medical and measurement technology, aerospace
• Knowledge-based services
  • > 11% of employees with university degrees and > 4,5% natural scientists and engineers
  • Printing and publishing, telecommunication, financial services (banking, insurance), data processing, R&D services, business services, health and social services, cultural industries, entertainment, sports
  • Sub-group: Knowledge-intensive business services (KIBS) ⇒ bridges in systems of innovation (cf. Czarnitzki/Spielkamp 2003, BMWi 2009)

Delineating the Knowledge Economy in Germany

Cf. Belitz et al. 2012, p. 8; Gehrke et al. 2013, p. 6-7

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R&D Intensity by Manufacturing Industry

- Pharmaceutical industry
- Data processing, electronic and optical equipment
- Automotive industry
- Aerospace industry
- Chemical industry
- Mechanical engineering
- Electrical equipment
- Mfg. of other vehicles
- Plastics & rubber processing

- > 9% = cutting-edge technology
- 3% - 9% = high technology
- > 3% = R&D intensive

KBE: International Comparison

Share of national GVA

- Knowledge-intensive services
- Cutting-edge technology
- High technology

Sweden, USA, Switzerland, Germany, UK, France, South Korea, Japan
### Knowledge Infrastructure & Economy: Dimensions

<table>
<thead>
<tr>
<th>Dimensions/Sectors</th>
<th>Relevance</th>
</tr>
</thead>
</table>
| **Universities = Knowledge Infrastructure** | • Research ⇒ invention  
• Human capital accumulation (vgl. Harding et al. 2007, Varga 2009, Schiller/Kiese 2010)  
• Antenna function (Fritsch/Schwirten 1998) |
| **Innovation potential (R&D, patents)** | • Driver of economic growth (Fritsch et al. 1998, Romer 1986, 1990)  
• Absorptive capacity (Cohen/Levinthal 1989, 1990) |
| **Human capital**                       | • Driver of economic growth (Romer 1986)  
• Diffusion, absorption |
| **Entrepreneurship**                    | • Commercialising new knowledge = innovation (Schumpeter 1934) |
| **Cultural & creative economy**         | • Creative class (Florida 2002)  
• Symbolic knowledge base (Asheim/Gertler 2005; Martin 2012) |

### Outline

1) The Knowledge Metropolis

2) **Knowledge Infrastructure in the Ruhr**

3) Knowledge Economy in the Ruhr

4) Conclusion and Outlook
27 Universities in 38 Locations

- University of Applied Science
- University of the Arts
- University
- University of Public Administration

2,792 professors
42,685 staff
274,714 students

More than 50 Years of Universities in the Ruhr

Years refer to establishment by the NRW state government
*) merger of universities Duisburg and Essen

RVR 2017, p. 2

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Student Population Rises Rapidly...

University Students: Metropolitan Regions

- The Ruhr is the metropolitan region with the highest number of university students in Germany.
- Measured against population size, Mitteldeutschland has more university students.
- Without distance learning at the Fern-Uni Hagen, the Ruhr would fall back to 6th rank (No. 4 on per capita basis).
- The number of university students in the Ruhr increased faster than in any other metropolitan region.

Data: Kriegesmann et al. 2015, p. 11
The Ruhr increasingly attracts students from other German states.

Data: RVR 2017, p. 5

...But Staff Growth Does Not Keep Pace!

- Total staff growth: +47.1%
- Scientific and artistic staff: +54.1%
- Administrative, technical and other staff: +34.9%

Data: RVR 2017, p. 9
Expenditure on Tertiary Education: OECD Countries

- Germany trails most advanced economies in terms of higher education expenditure.
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Student-Professor Ratio: German States (2015/2016)

<table>
<thead>
<tr>
<th>Region</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Rhine-Westphalia</td>
<td>82.1</td>
</tr>
<tr>
<td>Hesse</td>
<td>76.2</td>
</tr>
<tr>
<td>Bavaria</td>
<td>74.8</td>
</tr>
<tr>
<td>Rhineland-Palatinate</td>
<td>70.7</td>
</tr>
<tr>
<td>Lower Saxony</td>
<td>70.6</td>
</tr>
<tr>
<td>Berlin</td>
<td>67.9</td>
</tr>
<tr>
<td>Baden-Württemberg</td>
<td>67.1</td>
</tr>
<tr>
<td>Brandenburg</td>
<td>62.8</td>
</tr>
<tr>
<td>Saarland</td>
<td>62.1</td>
</tr>
<tr>
<td>Schleswig-Holstein</td>
<td>62.4</td>
</tr>
<tr>
<td>Hamburg</td>
<td>62.5</td>
</tr>
<tr>
<td>Saxony</td>
<td>61.5</td>
</tr>
<tr>
<td>Saxony</td>
<td>61.3</td>
</tr>
<tr>
<td>Mecklenburg-Vorpommern</td>
<td>54.2</td>
</tr>
<tr>
<td>Bremen</td>
<td>53.4</td>
</tr>
<tr>
<td>Thuringia</td>
<td>51.9</td>
</tr>
</tbody>
</table>

NRW trails all other German Länder.

Brain-Flow Balance of University Graduates*

<table>
<thead>
<tr>
<th>Group</th>
<th>Origin</th>
<th>Retention</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retained</td>
<td>Ruhr</td>
<td>Yes</td>
<td>35%</td>
</tr>
<tr>
<td>Lost</td>
<td>Ruhr</td>
<td>No</td>
<td>25%</td>
</tr>
<tr>
<td>Acquired</td>
<td>Other</td>
<td>Yes</td>
<td>13%</td>
</tr>
<tr>
<td>Transit</td>
<td>Other</td>
<td>No</td>
<td>27%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

Brain-flow balance
13% gained – 25% lost = -12%

*) Graduation cohort of 2011; without follow-up programmes, further education etc. (n=1,088)
Data: Kriegesmann et al. 2015, p. 18
**Brain-Flow Balance by Academic Discipline**

<table>
<thead>
<tr>
<th>Discipline</th>
<th>n</th>
<th>Origin in the Ruhr</th>
<th>Retention in the Ruhr</th>
<th>Brain-Flow Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philology, cultural studies</td>
<td>497</td>
<td>66%</td>
<td>64%</td>
<td>-2%</td>
</tr>
<tr>
<td>Economics, law, social sciences</td>
<td>751</td>
<td>63%</td>
<td>50%</td>
<td>-13%</td>
</tr>
<tr>
<td>Engineering</td>
<td>485</td>
<td>62%</td>
<td>51%</td>
<td>-11%</td>
</tr>
<tr>
<td>Mathematics and natural sciences</td>
<td>421</td>
<td>60%</td>
<td>64%</td>
<td>+4%</td>
</tr>
<tr>
<td>Total</td>
<td>2,154</td>
<td>63%</td>
<td>56%</td>
<td>-7%</td>
</tr>
</tbody>
</table>

- **Negative brain flow (brain drain)** uncharacteristic of metropolitan regions
- Possible explanations
  - high share of regional student input
  - Limited demand for university graduates in regional labour market (knowledge economy)

*) graduation cohort of 2011
Data: Kriegesmann et al. 2015, p. 18; own calculations

**Share of Employees with University Degrees, 2015**

- Highly **uneven** distribution
- Urban-rural divide
- Reflects distribution of universities

<table>
<thead>
<tr>
<th>County/City</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erlangen (City)</td>
<td>31.8</td>
</tr>
<tr>
<td>Munich (City)</td>
<td>30.0</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>22.2</td>
</tr>
<tr>
<td>Cologne</td>
<td>21.3</td>
</tr>
<tr>
<td>Essen</td>
<td>16.5</td>
</tr>
<tr>
<td>Dortmund</td>
<td>15.1</td>
</tr>
<tr>
<td>Bochum</td>
<td>14.7</td>
</tr>
<tr>
<td>Duisburg</td>
<td>11.8</td>
</tr>
</tbody>
</table>

Data and map: BBSR 2018
The Ruhr – A Science-based Metropolis?

Relevance

- 275,000 university students
- 2,800 university professors
- Direct & indirect employment effect of 50,000 (2.3% of regional employment)
- Demand effect of €2.3 bn. p.a. through universities incl. their employees and students (1.5% of regional GDP)

Cf. Kriegesmann et al. 2015

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Share of Employees in Knowledge-intensive Manufacturing, 2015

- West-east divide
- South-north divide
- Weak position of the Ruhr

<table>
<thead>
<tr>
<th>County/City</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolfsburg</td>
<td>57.0</td>
</tr>
<tr>
<td>Germany</td>
<td>10.2</td>
</tr>
<tr>
<td>Munich (City)</td>
<td>8.7</td>
</tr>
<tr>
<td>Cologne</td>
<td>6.8</td>
</tr>
<tr>
<td>Dortmund</td>
<td>6.5</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>5.7</td>
</tr>
<tr>
<td>Bochum</td>
<td>4.6</td>
</tr>
<tr>
<td>Duisburg</td>
<td>4.7</td>
</tr>
<tr>
<td>Essen</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Data & Map: BBSR 2018

R&D in the Business Sector, 2011

- Inputs for knowledge production ⇒ Product / process innovation

Data: Arndt et al. 2015, p. 83

R&D Expenditure as % of Turnover

R&D Personnel as % of Staff

- Germany
  - 2.0% (R&D Expenditure)
  - 1.3% (R&D Personnel)
- West Germany
  - 2.1%
- NRW
  - 1.2%
- The Ruhr
  - 0.8%

- Germany
  - 1.4%
- West Germany
  - 1.4%
- NRW
  - 0.9%
- The Ruhr
  - 0.6%
Share of Employees in R&D, 2011

- South-north divide
- Urban-rural divide
- Large mfg. firms in R&D intensive industries

<table>
<thead>
<tr>
<th>County/City</th>
<th>Share (per 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groß-Gerau</td>
<td>91.1</td>
</tr>
<tr>
<td>Munich (city)</td>
<td>37.5</td>
</tr>
<tr>
<td>Germany</td>
<td>12.6</td>
</tr>
<tr>
<td>Cologne</td>
<td>11.1</td>
</tr>
<tr>
<td>Essen</td>
<td>7.2</td>
</tr>
<tr>
<td>Dortmund</td>
<td>8.3</td>
</tr>
<tr>
<td>Bochum</td>
<td>6.7</td>
</tr>
<tr>
<td>Duisburg</td>
<td>6.5</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>6.2</td>
</tr>
</tbody>
</table>

Data and map: [www.inkar.de](http://www.inkar.de) [21.10.2015]

Share of Employees in R&D, 2015

Business sector by planning region

Eckl et al. 2017, p. 40
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Patent Applications per 100,000 employees (2011/2012)

Data: Arndt et al. 2015, p. 84
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New Firm Formation

NFF per 10,000 working-age population, 2009/2012

Change over 2005/2008

Data: Arndt et al. 2015, p. 69
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- Formation rate typically below average in regions with early industrialisation
- The Ruhr lagging behind only slightly, but...
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Knowledge-intensive NFF per 10,000 workforce

- Germany
- West Germany
- The Ruhr

Arndt et al. 2015, p. 70
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Knowledge-intensive Entrepreneurship*, 2012-2016

- Urban-rural divide
- North-South divide
- Nuclei = Cities with technical universities, but none in the Ruhr

<table>
<thead>
<tr>
<th>County/City</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jena</td>
<td>16.3</td>
</tr>
<tr>
<td>Munich (City)</td>
<td>12.0</td>
</tr>
<tr>
<td>Cologne</td>
<td>9.6</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>7.5</td>
</tr>
<tr>
<td>Germany (2016)</td>
<td>7.1</td>
</tr>
<tr>
<td>Dortmund</td>
<td>6.4</td>
</tr>
<tr>
<td>Bochum</td>
<td>6.1</td>
</tr>
<tr>
<td>Duisburg</td>
<td>5.7</td>
</tr>
<tr>
<td>Essen</td>
<td>5.6</td>
</tr>
</tbody>
</table>

* High-tech industries & KIBS; Data & maps: Creditreform 2017

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University-based Entrepreneurship (Spin-offs)

EXIST entrepreneurship grants, 2007-2015

- Berlin: 204
- Munich: 99
- Dresden: 57
- The Ruhr: 40
- Potsdam: 38
- Karlsruhe: 37
- Aachen: 35
- Stuttgart: 34
- Köln: 29
- Hamburg: 24
- Bremen: 19
- Darmstadt: 18

Data: Kriegesmann et al. 2015, p. 47

Germany 2014
- Ca. 1.6 million jobs
- 3.5% of total employment
- 2.2% of GDP

(BMWi 2016, p. 13)
Symbolic Knowledge Base: Creativity

- **Symbolic knowledge base**
  - Based on arts and culture
  - Intangible products
  - Individual and context-specific knowledge (**creativity**)
  - Short-term, flexible **project organisation**
  - **networks, know-who** ⇒ reputation, Reciprocity
  - Examples: Film industry, music industry, fashion, design, marketing...

- “jobs follow people” or “people-driven economy”
  - Power of place: creative Milieu more important than local supply of jobs
  - People climate: Culture and lifestyle as drivers of economic development

- 3 Ts
  - **Technology**
  - **Talent** (e.g., bohemian index)
  - **Tolerance** (diversity, e.g. gay index)

Cf. Florida 2002; Asheim/Gertler 2005; Martin 2012, p. 1572

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Share of Employment in Creative Industries (2015)

- Highly **uneven** distribution
- Strong but not exclusively focused on large urban agglomerations

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<td>Munich (City)</td>
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<tr>
<td>Düsseldorf</td>
<td>5.6</td>
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<td>Essen</td>
<td>4.1</td>
</tr>
<tr>
<td>Bochum</td>
<td>3.8</td>
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<tr>
<td>Germany</td>
<td>3.5</td>
</tr>
<tr>
<td>Dortmund</td>
<td>3.5</td>
</tr>
<tr>
<td>Duisburg</td>
<td>1.9</td>
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</table>

Data and map: BBSR 2018

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Cultural and Creative Economy (CCE) in the Ruhr

- Significant efforts, esp. with European Capital of Culture 2010 (cf. Heinze-Hoose 2011)

- White hope
  - Interim use of vacant property
  - Pioneers for upgrading urban spaces
  - Structural change

- Turnover, employees, GVA: Lower shares than in Düsseldorf, Cologne and other metropolitan regions in Germany

- Strengths in specific market segments, e.g. press, software/games development in Essen

- Challenges
  - Negative/weak population dynamics (outflow, ageing)
  - Partial lack of architectural and cultural substance


Dortmunder U Design at Zollverein

- 2008 decision to redevelop brewery into centre for CCE
- Calculated costs of € 46 m (EU 50%, NRW 20%, City 30%), realised for close to € 100 m
- Some artists’ initiatives, but hardly any spillovers into the neighbourhood (‘Bilbao effect’, cf. Mair-Boigk 2012; Laurin 2013)
- Ca. 40 firms with > 950 employees (WAZ 2013, Schürmann 2014)
- Folkwang University of the Arts opened in 2017
- Creative class prefers authentic urban quarters (Essen: Rüttenscheid, Nordstadt)
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The Ruhr in the Knowledge Economy: Summary

<table>
<thead>
<tr>
<th>Potential</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Infrastructure</td>
<td></td>
</tr>
<tr>
<td>• High density of universities</td>
<td>• Poor endowment (student-professor ratio)</td>
</tr>
<tr>
<td>• Large &amp; rapidly rising student</td>
<td>• Few public research organisations</td>
</tr>
<tr>
<td>population</td>
<td>• Low third-party research funding ⇒</td>
</tr>
<tr>
<td>• Well-established and innovative</td>
<td>• focus on education</td>
</tr>
<tr>
<td>instruments for technology</td>
<td></td>
</tr>
<tr>
<td>transfer</td>
<td></td>
</tr>
</tbody>
</table>
What Should Be Done?

- **Strengthen knowledge infrastructure**
  - Funding for universities needs to be increased!
  - Attract/expand research organisations (Fraunhofer, Max Planck…)
- **Develop transfer infrastructure**
  - New concepts, e.g. WorldFactory
  - Adapt old concepts (incubators, technology parks)
- **Strengthen the regional knowledge economy**
  - Attract knowledge-based firms
  - Improve entrepreneurial climate/culture/ecosystem (universities ⇒ education system), promote role models
  - Absorptive capacity for graduates ↑ ⇒ brain drain ↓

Research Outlook

- **Channels of and obstacles to regional knowledge and technology transfer**
  - Contract & collaborative research
  - Commissioned student works, teaching assignments to firm staff
  - Graduate employment
  - University spin-offs
- **Identification (mapping) of regional knowledge networks**
- **Knowledge-based urban and regional development**
  - Master plans in Bochum und Dortmund
  - Development of university quarter in Essen
  ⇒ Metropolitan research field of competence of the Ruhr university alliance
References (1/6)


References (2/6)


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References (3/6)


References (4/6)


References (5/6)


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