Structural Change in the Ruhr: Towards a Knowledge-based Economy?

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Institute of Geography • Urban and Regional Economics
RUHR-UNIVERSITÄT BOCHUM

November 21st, 2016 • 18-20 hrs • HZO 60

The Ruhr

Map: [http://upload.wikimedia.org/wikipedia/commons/9/97/Ruhr_area-map.png](http://upload.wikimedia.org/wikipedia/commons/9/97/Ruhr_area-map.png) [24 Oct, 2016]
**Regional Competitiveness: Ruhr Falling Behind?**

IW-Studie

Revier fällt im Wettstreit der attraktivsten Regionen zurück

13.04.2016 | 05:00 Uhr

- Ranking of 402 counties and county-free cities in Germany by economic performance, labour market and quality of life
- Five Ruhr cities among the bottom ten

Das Thyssen Krupp-Stahwerk im Duisburger Norden: Die Stadt lebt auch von der Schwerindustrie. Trotzdem, so schreiben die IW-Experten, ist die Stadt im „Regionalranking“ das Schlusslicht. Foto: Hans Bissey

Im Regional-Ranking von 402 Städten und Kreisen liegen laut Institut der deutschen Wirtschaft Gelsenkirchen und Duisburg ganz hinten.

Kohlstadt/Münstermann 2016 (emphasis added)

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**„Bottom of the League“ Discourse in the Ruhr**

**IW Ranking**

- Lack of **innovation capacity**
- Insufficient **knowledge transfer** between science and businesses
- Lagging behind in **digital transformation** („Industrie 4.0“)
- Lack of **unity** (governance)

**WMR**

- “In contrast to pessimistic assessments, the Ruhr economy is clearly **catching up.**”
- 2014-2015 saw the creation of > 35,000 **new jobs in lead markets**, such as logistics and the healthcare industry
- “The figures show that structural change is on the right track.”

Cf. Kohlstadt/Münstermann 2016 (own translation, emphasis added)

Structural Change in the Ruhr?

“A region struggling with structural change.” (Goch 2002)

“NRW’s manufacturing heart no longer beats in the Ruhr.” (Northaue-Janz 2002)

“Structural change has been successfully completed.”

Ruhr-Soli – The Ruhr needs help from outside!

“You cannot say that the Ruhr stayed behind because there were too few subsidies from outside. This is one of many grand self-delusions which are being maintained in a cult-like manner.” (Lammert, quoted in WDR 2015)

“Reached a lot – little gained” (Bogumil et al. 2012)

Own translations, emphasis added

Key Questions

- What is the status of structural change in the Ruhr?
- What does “transition to a knowledge economy” mean?
- How far has the Ruhr come in this transition?
- How can this transition be promoted, and what challenges need to be overcome?
Outline

1) Structural Change in the Ruhr

2) Structural Change: Theoretical Explanations

3) Structural Change 2.0: Towards the Knowledge Economy

4) The Ruhr in the Knowledge Economy

5) Challenges: The Case of Bochum

Structural Change in Action: Solidarity for Opel, March 2013

### Gross Value Added (GVA) by Sector, 2000-2012

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Agriculture &amp; Forestry</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Mining, Energy, Construction</td>
<td>9.5%</td>
<td>9.8%</td>
<td>12.9%</td>
<td>12.8%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>20.1%</td>
<td>19.8%</td>
<td>17.6%</td>
<td>17.4%</td>
</tr>
<tr>
<td>Services</td>
<td>70.2%</td>
<td>70.2%</td>
<td>69.1%</td>
<td>69.6%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Agriculture &amp; Forestry</td>
<td>0.7%</td>
<td>0.5%</td>
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<td>0.6%</td>
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<tr>
<td>Mining, Energy, Construction</td>
<td>6.7%</td>
<td>6.2%</td>
<td>7.1%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>24.0%</td>
<td>23.0%</td>
<td>21.9%</td>
<td>21.6%</td>
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<tr>
<td>Services</td>
<td>68.6%</td>
<td>70.3%</td>
<td>70.4%</td>
<td>70.6%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Sector</th>
<th>Germany 2000</th>
<th>Germany 2005</th>
<th>Germany 2010</th>
<th>Germany 2012</th>
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</thead>
<tbody>
<tr>
<td>Agriculture &amp; Forestry</td>
<td>1.1%</td>
<td>0.8%</td>
<td>0.8%</td>
<td>0.8%</td>
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<tr>
<td>Mining, Energy, Construction</td>
<td>8.2%</td>
<td>7.3%</td>
<td>8.3%</td>
<td>8.1%</td>
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<tr>
<td>Manufacturing</td>
<td>22.3%</td>
<td>22.0%</td>
<td>21.9%</td>
<td>22.4%</td>
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<tr>
<td>Services</td>
<td>68.4%</td>
<td>69.9%</td>
<td>69.0%</td>
<td>68.7%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

- Share of **manufacturing below average** in the Ruhr
- Manufacturing stable in Germany, but **declining** in NRW and the Ruhr

Data: RVR [Link to RVR data](http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/Bilder/Daten___Fakten/Regionalstatistik_PDF/Wirtschaftskraft/VWGBWS_U1_Tab.pdf) (18.04.2016)
Manufacturing GVA, 1992-2012

Arndt et al. 2015, p. 48
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Manufacturing Employment, 1996-2012

Arndt et al. 2015, p. 53
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1) Share of Manufacturing GVA; Data: Arndt et al. 2015, p. 55
2) Includes Mining, Energy & Construction; ** Germany excluding East Germany before 1990

Employment by Sector, 1964-2014

*) Includes Mining, Energy & Construction; **) Germany excluding East Germany before 1990

Share of Employment in Manufacturing*, 1964-2014

*) Includes Mining, Energy & Construction; **) Germany excluding East Germany before 1990


Geography of Employment in Manufacturing

Share of employment in manufacturing, 2013

- South-north divide
- West-east divide
- Large cities as service centres
- Sub- and disurbanisation of manufacturing
- The Ruhr is no longer a manufacturing heartland!

Anzahl der SV Beschäftigten im Sekundärssektor (KZ 2008) an den SV Beschäftigten in %

- unter 24,1
- 24,1 - 30,7
- 30,7 - 36,5
- 36,5 - 43,7
- 43,7 und mehr

Raumordnung, Kreise und kreisfreie Städte
Zahlenquellen: BBSR 2016
Grafik und Aufteilung: Beschäftigtenstatistik der Bundesagentur für Arbeit
Share of Manufacturing Employment by City/County, 2012

GVA in the Service Sector, 1992-2012

Arndt et al. 2015, p. 48
Employment in Services, 1996-2012

<table>
<thead>
<tr>
<th>Shares</th>
<th>1996</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Ruhr</td>
<td>68.5%</td>
<td>78.3%</td>
</tr>
<tr>
<td>Germany</td>
<td>66.5%</td>
<td>73.6%</td>
</tr>
</tbody>
</table>

Share of employment in services, 2013

- **Urban agglomerations** specialise in services
- Some **specialised service centres**, e.g. university towns (Freiburg, Heidelberg, Münster)

Geography of Employment in Services

Anzahl der SV Beschäftigten im Tertiärsektor (NZ 2008) an den SV Beschäftigten in %

- 10.0 – 15.0
- 15.0 – 20.0
- 20.0 – 25.0
- 25.0 – 30.0
- 30.0 – 35.0
- 35.0 – 40.0
- 40.0 – 45.0
- 45.0 – 50.0
- 50.0 – 55.0
- 55.0 – 60.0
- 60.0 – 65.0
- 65.0 – 70.0
- 70.0 – 75.0
- 75.0 – 80.0
- 80.0 – 85.0
- 85.0 – 90.0
- 90.0 – 95.0
- 95.0 – 100.0

Arndt et al. 2015, p. 54

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Geography of Business Services

Share of employment in Business Services, 2013

- **Agglomerate** more strongly than services in general

⇒ Focus on urban agglomerations/ large metropolitan regions


Energy and new energy technologies
- Information technology
- Medical devices & healthcare
- Microsystems & microelectronics
- Water & sewage technologies
- Mining technologies

Chemicals
- New materials incl. steel
- Mechanical engineering

Logistics
- Design
- Leisure & tourism

Rehfeld 2006, p. 250; Kiese 2012, p. 147
New Diversity: WMR’s „Lead Markets“

Lead Market: related services
related manufacturing
engineering services
Materials & processes
Core

Wichert 2014, p. 19; Lehner et al. 2015, p. 6

New Diversity: WMR’s “Lead Markets”

Lead Markets: Size, Growth and Specialisation (2013)

<table>
<thead>
<tr>
<th>Lead Market</th>
<th>Employment*</th>
<th>Share Ruhr</th>
<th>Location Quotient</th>
<th>Growth (2012-2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing core and business services</td>
<td>298,806</td>
<td>18.8%</td>
<td>1.14</td>
<td>3.3%</td>
</tr>
<tr>
<td>Healthcare</td>
<td>271,066</td>
<td>17.1%</td>
<td>1.11</td>
<td>1.7%</td>
</tr>
<tr>
<td>Urban construction &amp; living</td>
<td>178,818</td>
<td>11.3%</td>
<td>0.97</td>
<td>2.0%</td>
</tr>
<tr>
<td>Mobility</td>
<td>160,137</td>
<td>10.1%</td>
<td>0.86</td>
<td>0.9%</td>
</tr>
<tr>
<td>Sustainable consumption</td>
<td>116,047</td>
<td>7.3%</td>
<td>0.87</td>
<td>1.8%</td>
</tr>
<tr>
<td>Resource efficiency</td>
<td>94,364</td>
<td>6.0%</td>
<td>1.71</td>
<td>0.7%</td>
</tr>
<tr>
<td>Leisure &amp; events</td>
<td>79,988</td>
<td>5.0%</td>
<td>0.79</td>
<td>1.7%</td>
</tr>
<tr>
<td>Education &amp; knowledge</td>
<td>76,694</td>
<td>4.8%</td>
<td>1.02</td>
<td>-0.8%</td>
</tr>
<tr>
<td>Digital communication</td>
<td>44,825</td>
<td>2.8%</td>
<td>0.76</td>
<td>-0.8%</td>
</tr>
<tr>
<td>Total</td>
<td>1,320,745</td>
<td>83.2%</td>
<td>1.02</td>
<td>1.4%</td>
</tr>
</tbody>
</table>

Data: Lehner et al. 2015, p. 7; LQ: own calculation; *) covered by social insurance

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**GDP, 2000-2012 (2000 = 100)**

Data: RVR

http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/Bilder/Daten___Fakten/Regionalstatistik_PDF/Wirtschaftskraft/VWGBIP_12_Tab.pdf

Beware

Net commuter outflow ⇒ Data understate economic performance of the Ruhr!

**GDP per Capita, 1992-2012**

Arndt et al. 2015, p. 51

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GDP per Employee, 2000-2012 (Germany = 100)

Data: RVR
(http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/Bilder/Daten_Regionalstatistik_PDF/Wirtschaftskraft/VWGBIP_12_Tab.pdf [18.04.2016])

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GDP per Employee in €, 2012

Data: RVR; CAGR = Compound Annual Growth Rate
(http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/Bilder/Daten_Regionalstatistik_PDF/Wirtschaftskraft/VWGBIP_12_Tab.pdf [18.11.2016])

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Disposable Household Income, 1975-2013 (Germany* = 100)

<table>
<thead>
<tr>
<th></th>
<th>1975-2013</th>
<th>1995-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Ruhr</td>
<td>+3.3%</td>
<td>+1.4%</td>
</tr>
<tr>
<td>NRW</td>
<td>+3.6%</td>
<td>+1.6%</td>
</tr>
<tr>
<td>Germany</td>
<td>+3.5%</td>
<td>+1.9%</td>
</tr>
</tbody>
</table>

Data: RVR; *) excluding East Germany until 1990

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Disposable Household Income: Cities and Counties, 2004-2013

Data: RVR; CAGR = Compound Annual Growth Rate
(http://www.metropoleruhr.de/fileadmin/user_upload/metropoleruhr.de/Bilder/Daten_Daten/Regionalstatistik_PDF/Wirtschaftskraft/VWGEink_13neu_Tab.pdf [18.11.2016])

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Unemployment Rates, October 2016

Spatial Cumulation of Employment Risks
- "Culture of unemployment" in some urban districts
- Skills deficits prevent transition to service sector
- Social polarisation and exclusion (Cf. Bogunil et al. 2012, p. 50)

Data: Federal Labour Agency (Bundesagentur für Arbeit)

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Unemployment Rates, 1960-1988

The Ruhr 1968-1972 without Wesel county; Data: RVR
(http://www.metropolieruhr.de/fileadmin/user_upload/metropolieruhr.de/Bilder/Daten___Fakten/Regionalstatistik_PDF/Arbeitsmarkt/06_Zeitr_Arbeitsmarkt15.pdf [18.11.2016])

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Unemployment Rates, 1991-2015*

- The Ruhr
- NRW
- Germany

Δ = ca. 2 percentage points
Δ = 3.5-4.5 percentage points


*) end-September, except Germany 1991-1994: annual average; Data: RVR, StBA
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Labour Force Mobilisation*, 2013

- Total
- Women
- Foreigners

The Ruhr - NRW - West Germany - Germany

*) Employees as share of working-age population (15 to below 65 years)
Data: Arndt et al. 2015, p. 63
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Structural Change in the Ruhr: Preliminary Conclusions

- **Deindustrialisation/Tertiarisation** well advanced
  - Increasing linkages manufacturing ↔ business services in hybrid value chains
  - Below-average presence of manufacturing = weakness

- **Legacy of structural change**
  - Spatial & sectoral fragmentation of structures and trajectories
  - Backwardness in value added and labour productivity, but catching up
  - Structural unemployment
  - Persistent income gap, esp. disposable household income falling behind

Outline

1) Structural Change in the Ruhr

2) **Structural Change: Theoretical Explanations**

3) Structural Change 2.0: Towards the Knowledge Economy

4) The Ruhr in the Knowledge Economy

5) Challenges: The Case of Bochum
Structural Change: Theoretical Explanations

- **Technological Change**
  - Three-sector hypothesis
  - Long waves of economic development (Kondratieff cycles)
  - Product life cycle hypothesis

- **Globalisation = catalyst**
- Formerly successful routines transforming into obstacles to adaptation when facing radical changes in the environment = *lock-ins*
  - organisational
  - technological
  - political/institutional
  - cognitive/psychological

Three-Sector Hypothesis

Figure: http://faculty.washington.edu/krumme/207SMSectors1.jpg [21 November 2013]
Three-Sector Hypothesis

- Economic development is accompanied by a shift of output and employment from the primary to the secondary to the tertiary sector
  - Primary: agriculture, natural resources
  - Secondary: manufacturing
  - Tertiary: services

- Rapid change ⇒ rapid economic growth

- Reasons
  - Supply: Differences in productivity growth: Factors of production (capital, labour) move from agriculture to manufacturing to services
  - Demand: Differences in the income elasticity of demand: With rising incomes, the composition of demand shifts from agricultural products to manufactures to services

Cf. Liefner/Schätzl 2012, p. 100

Sectoral Change: Structure of Employment in Germany

Kulke 2010, p. 7
### Sectoral Change: Structure of Employment in Germany

<table>
<thead>
<tr>
<th>Year</th>
<th>Tertiary Sector</th>
<th>Secondary Sector</th>
<th>Primary Sector</th>
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</thead>
<tbody>
<tr>
<td>1991</td>
<td>60%</td>
<td>30%</td>
<td>10%</td>
</tr>
<tr>
<td>1995</td>
<td>55%</td>
<td>35%</td>
<td>10%</td>
</tr>
<tr>
<td>2000</td>
<td>50%</td>
<td>35%</td>
<td>15%</td>
</tr>
<tr>
<td>2005</td>
<td>45%</td>
<td>35%</td>
<td>20%</td>
</tr>
<tr>
<td>2010</td>
<td>40%</td>
<td>35%</td>
<td>25%</td>
</tr>
<tr>
<td>2014</td>
<td>35%</td>
<td>35%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Data: StBA 2015, p. 349

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### Accounting for the Recent Rise of Service Industries

- **Externalisation**: Manufacturing firms tend to outsource more and more services they formerly used to perform themselves.
- **Interaction**: Globalisation, intensified competition and shorter product cycles drives demand for services, esp. knowledge-intensive business services (KIBS, see below)
- **Parallelism/Innovation**: Supply of new services creates specific demand (e.g. investment banking, solariums)

What is (Economic) Globalisation?

- **Globalisation** = Process of increasing interconnectedness of economic activity (production, consumption) through the mobility of
  - goods and services
  - Factors of production
    - **Labour** = physical and intellectual work performed by humans
    - **Capital** = all goods used for the production of other goods (e.g., raw materials, machinery, equipment, building, financial means)
    - **Technology** = knowledge of goods, processes and organisation

Cf. Schätzl 2000, p. 123

Phases of Globalisation

- Expansion of colonial trading system from mid-18th century
- 1914-1945: Disintegration due to World Wars and Great Depression

Own illustration based on Schätzl 2000, pp. 124 f.
Cycles in Economic Development

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Duration</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchin Cycle</td>
<td>3-4 years</td>
<td>Firm level: production and sales planning, stock-keeping periods</td>
</tr>
<tr>
<td>Jugar Cycle</td>
<td>9-10 years</td>
<td>Investment periods</td>
</tr>
<tr>
<td>Kondratieff Cycle</td>
<td>50-60 years</td>
<td>Innovations</td>
</tr>
</tbody>
</table>

- Long-term fluctuations of production, wages and prices in capitalist economies (Kondratieff 1926)
- Explanation: technological innovation and investments in capital goods

Picture: http://upload.wikimedia.org/wikipedia/commons/0/04/%D0%9D%D0%B8%D0%B2%D0%BE%D0%B6%D0%BD%D0%B9_%D0%9A%D0%BE%D0%BD%D1%80%D0%B7%D0%B1%D0%82%D1%8B%D0%B2.JPG

Long Waves of Economic Development

- Basic technological novelties **(basic innovations)** occur in regular timespans and trigger long periods of economic growth.
  - Pioneer entrepreneur
  - New markets and growth industries
  - Transformation of existing industries through process innovations
  - Example: Semiconductors ⇒ microelectronics revolution, ICT industry

- Exhaustion of basic innovation
  ⇒ Economic stagnation / decline
  ⇒ Increasing investment in search for new basic innovations
  ⇒ Next cycle

Cf. Schätzl 2003, pp. 218-219; picture: http://www.eumed.net/cursecon/economistas/schumpeter.jpg

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### Long Waves (Kondratieff Cycles)

**Kulke 2013, p. 103 (own translation)**

<table>
<thead>
<tr>
<th>Economic Growth</th>
<th>1(^{st}) wave</th>
<th>2(^{nd}) wave</th>
<th>3(^{rd}) wave</th>
<th>4(^{th}) wave</th>
<th>5(^{th}) Wave</th>
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<tbody>
<tr>
<td>1779</td>
<td>1800</td>
<td>1825</td>
<td>1879</td>
<td>1900</td>
<td>1925</td>
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<tr>
<td>1850</td>
<td>1879</td>
<td>1900</td>
<td>1925</td>
<td>1950</td>
<td>1975</td>
</tr>
<tr>
<td>1975</td>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Steam engine
- Textile industry
- Iron industry
- Railway
- Iron and steel industry
- Electricity
- Chemical industry
- Automotive industry
- Electronics
- Petrochemicals
- Synthetic materials

**Basic technologies and key industries**

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### Long Waves in Spatial Perspective

**a) Within a Long Wave**

- New industries **concentrated** in few centres
  ⇒ **High-tech regions**

- Subsequent formation of a wave-specific global system of locations

- **Interconnected** through the mobility of goods and factors of production

- End of wave ⇒ further decentralisation of activity = **dispersion**

Cf. Schätzl 2003, pp. 220-222


High-tech region Silicon Valley
b) Between two Long Waves

- New wave forms its own centre, generally far away from old centres of activity
  - Precondition: Certain density of population, firms and infrastructure
  - Advantage of new centre: open-mindedness, risk-taking attitude, low factor costs, adaptable workforce


Long Waves in Spatial Perspective

b) Between two long waves

- Old centres do not meet the locational requirements of new growth industries
  - Land: Limited supply, high costs, often contaminated
  - Labour: High wages, skills shaped by old industries
  - Investment focused on the conservation of existing industries; risk aversion reduces potential for innovation and entrepreneurship ⇒ new industries
  - Infrastructure designed for the needs of old industries
  - Structural changed impeded by alliances of politics, large firms and trade unions

⇒ Old industrial region

Demolition of a steel mill in Utah, U.S.
swe4.jpg [31 May 2011]
Why do Industrial Regions Mature?

- Formerly successful routines block adaptation to changing environments = Lock-ins
  - organisational
  - technological
  - political / institutional
  - cognitive, psychological
- Conservative identity of interests in networks of firms, policymakers and trade unions
  - Hindrance alliances: Developmental deadlock through regional networks (Grabher 1993a)
  - „weakness of strong ties“ (Grabher 1993b)

⇒ Reduce ability to adapt to changing demand and technology, esp. when facing radical innovation

Diversity and Specialisation in a Region’s Life Cycle

- Development and introduction
- Growth
- Maturity
- Decline

Output/sales

Diversity ⇒ Specialisation (lock-in)

„critical mass“
Examples of Regional Lock-in

- Old industrial regions (e.g., the Ruhr, cf. Bronny et al. 2004, Hospers 2004)
  - Focus on mature and declining industries = impediment to change
  - ignoring potential of microcomputers (IBM)
  - overtaken by Silicon Valley as leading high-tech region
- Optical industry in and around Wetzlar (Hesse, Germany, cf. Mossig/Klein 2003)
  - Missing shift towards digital photography
  - Losing market to Japanese competitors
- Watch industry in the Swiss Jurassic Arc (cf. Corpataux et al. 2002)
  - Missing trend towards quartz technology
  - Losing mass market to Japanese competition

No Determinism: Regions do not Mature Automatically

- Development and introduction
- Growth
- Maturity
- Decline

No Determinism: Regions do not Mature Automatically

Menzel/Fornahl 2010, p. 218 (modified)
Renewal and Transformation of Regions

Example 1: Swiss Watch Industry

- **Decline** from 1970s to mid-1980s
  - *Lock-in*: Quartz technology ignored
  - Employment shrank from 48,000 (1975) to 23,000 (1995)
- **Renewal** through restructuring in the 1980s
  - Swatch group; marketing & design; specialisation on high-value watches
- **Transformation** to **medical device industry** based on competence in precision engineering (=overlapping knowledge base)
  - Reorientation of firms (temporary)
  - Common supplier base
  - Shred research and training organisations
  - Migration of workers

Cf. Corpataux et al. 2002

Example 2: Silicon Valley

<table>
<thead>
<tr>
<th>Early 20th century</th>
<th>Historical precursors: Electrical industry, esp. radio technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>Stanford Industrial Park, Establishment of the first der microelectronics firms</td>
</tr>
<tr>
<td>1960s</td>
<td>Firm population grows through spin-offs, Contracts from NASA and U.S. Institute of Defense</td>
</tr>
<tr>
<td>1970s</td>
<td>Civil demand for microprocessors, followed by consolidation, Start of microcomputer (PC) era</td>
</tr>
<tr>
<td>1980s</td>
<td>Growing dominance of microcomputer industry, Internationalisation of production, job losses, New generation of innovative spin-offs</td>
</tr>
<tr>
<td>1990s</td>
<td>Internet firms (“Dot Bowl”)</td>
</tr>
<tr>
<td>2000s</td>
<td>Web 2.0, Cleantech</td>
</tr>
</tbody>
</table>

Silicon Valley: Drivers of Structural Change

- Complex interaction of contingent factors
  - Renowned research university (Stanford)
  - Human capital (incl. immigration)
  - Public demand for high-risk innovative products
  - High job mobility
  - Informal networks
  - Endogenous venture capital
  - Entrepreneurial culture / climate

Cf. Kiese 2016

Renewal and Transformation in the Ruhr?

- Intensive efforts at breaking path dependency, e.g. biotechnology, creative industries, design...

- Selective evidence of cluster transition
  - Technological Spillover: mining engineering ⇒ green technology (environmental engineering), safety engineering, microsystems technology
  - Specialised demand
    - Coalmining ⇒ lung diseases ⇒ health services
    - Coalmining ⇒ environmental damages ⇒ environmental engineering
Outline

1) Structural Change in the Ruhr
2) Structural Change: Theoretical Explanations
3) Structural Change 2.0: Towards the Knowledge Economy
4) The Ruhr in the Knowledge Economy
5) Challenges: The Case of Bochum

Forms of Knowledge

- Knowledge
  - explicit
    - Know-what: information
  - implicit / tacit
    - Know-why: abilities, skills
    - Know-how: relations, networks
    - Know-who

Based on Polanyi 1966 and Lundvall/Johnson 1994, p. 271
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)
- Increasing codification ⇒ information ↑
- Costs of knowledge sourcing and diffusion ↓
- Networks as hybrid forms of knowledge (cf. Arrow 1994)

Delineating the Knowledge Economy in Germany

- R&D-intensive manufacturing industries by share of turnover spent on internal R&D
  - High technology (Hochtechnologie)
    - R&D intensity: 2,5%-7%
    - Chemical industry, mechanical engineering, electrical equipment, automotive industry, other vehicles
  - Cutting-edge technology: R&D intensity > 7%
    - 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 2002, BMWi 2009)
R&D Intensity by Industry

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

Internal R&D Expenditure as a Percentage of Turnover with own Products

- > 7% = cutting-edge technology
- 2.5% - 7% = high technology
- > 2.5% = R&D intensive

KBE: International Comparison

Share of national GVA

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

EFI 2016, p. 109
EFI 2016, p. 127
Knowledge Economy: Dimensions and Strategies

Creation

Acquisition

Producing ideas

Using ideas

Application

Diffusion

Own representation, drawing on Toh et al. 2002, Romer 1993

Outline

1) Structural Change in the Ruhr
2) Structural Change: Theoretical Explanations
3) Structural Change 2.0: Towards the Knowledge Economy
4) The Ruhr in the Knowledge Economy
5) Challenges: The Case of Bochum
The Ruhr in the Knowledge Economy: Overview

- Innovation capacity (research and development, patents)
- Human capital
- Higher education
- Entrepreneurship
- Creative Economy

Share of Employees in Knowledge-intensive Manufacturing, 2013

- 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>53.9</td>
</tr>
<tr>
<td>Germany (∅)</td>
<td>10.3</td>
</tr>
<tr>
<td>Munich (city)</td>
<td>8.8</td>
</tr>
<tr>
<td>Bochum</td>
<td>7.3</td>
</tr>
<tr>
<td>Cologne</td>
<td>7.0</td>
</tr>
<tr>
<td>Dortmund</td>
<td>6.2</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>6.1</td>
</tr>
<tr>
<td>Duisburg</td>
<td>4.9</td>
</tr>
<tr>
<td>Essen</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Data and map: BBSR 2016
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]

R&D in the Business Sector

- Inputs for knowledge production ⇒ Product / process innovation

<table>
<thead>
<tr>
<th>Germany</th>
<th>R&amp;D Expenditure as % of Turnover</th>
<th>2.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Germany</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>NRW</td>
<td>1.2%</td>
<td></td>
</tr>
<tr>
<td>The Ruhr</td>
<td>0.8%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Germany</th>
<th>R&amp;D Personnel as % of Staff</th>
<th>1.3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Germany</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>NRW</td>
<td>0.9%</td>
<td></td>
</tr>
<tr>
<td>The Ruhr</td>
<td>0.6%</td>
<td></td>
</tr>
</tbody>
</table>
Patent Applications per 100,000 employees (2011/2012)

<table>
<thead>
<tr>
<th>Region</th>
<th>Patent Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>116</td>
</tr>
<tr>
<td>West Germany</td>
<td>132</td>
</tr>
<tr>
<td>NRW</td>
<td>80</td>
</tr>
<tr>
<td>The Ruhr</td>
<td>60</td>
</tr>
</tbody>
</table>

Data: Arndt et al. 2015, p. 84

50 Years of Universities in the Ruhr

http://aktuell.ruhr-uni-bochum.de/mam/images/2014/fittoresize_440_0_abe65bd3d2a5d04285d257fa7ac56502_stil-leben_a40.jpeg
http://www.ruhr-guide.de/artikel_pix/RUB_68.0071.jpg
https://www.bochum.de/C12571A3001D56CE/vwContentByKey/W29RXCWN386BOCMDE/$FILE/1965_Baustelle_RuhrUniversitaet_29_Juni_1965_gross.jpg [09.10.2015]
University Students in the Ruhr

- 260,211 students, of which 70,000 distance learning (Fernuni Hagen)
- 36.8% of students in law, management & economics and social sciences (NRW: 29.2%)
- Student numbers exceed absorptive capacity of regional labour market ⇒ Outmigration of graduates (brain drain)
- Quantitative input indicator

Rest of NRW

The Ruhr

Kriegesmann et al. 2015, p. 1

RVR 2016

Winter Semester 2014/2015

- Index WS 1999/2000=100

The Ruhr

Rest of NRW

Kriegesmann et al. 2015, p. 1
University Students in the Ruhr

The Ruhr
- 28% of NRW's population
- 36% of NRW's univ. students (without distance learning: 29%)

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

University Students: Metropolitan Regions

<table>
<thead>
<tr>
<th>Rank</th>
<th>Metropolitan Region</th>
<th>Population (m)</th>
<th>Univ. Students (WS 2013/2014)</th>
<th>Change over WS 2007/2008</th>
<th>Students per 1,000 inhabitants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Ruhr</td>
<td>5.05</td>
<td>261,500</td>
<td>68.7%</td>
<td>51.8</td>
</tr>
<tr>
<td>2</td>
<td>Hesse-Ruhr excl. the Ruhr</td>
<td>4.91</td>
<td>233,000</td>
<td>39.1%</td>
<td>47.8</td>
</tr>
<tr>
<td>3</td>
<td>Frankfurt-Rhein-Main</td>
<td>5.55</td>
<td>221,900</td>
<td>26.0%</td>
<td>40.0</td>
</tr>
<tr>
<td>4</td>
<td>Berlin-Brandenburg</td>
<td>5.93</td>
<td>215,500</td>
<td>20.3%</td>
<td>36.3</td>
</tr>
<tr>
<td>5</td>
<td>Mitteldeutschland</td>
<td>2.40</td>
<td>204,800</td>
<td>-2.3%</td>
<td>85.3</td>
</tr>
<tr>
<td>6</td>
<td>Munich</td>
<td>5.71</td>
<td>167,000</td>
<td>38.7%</td>
<td>29.2</td>
</tr>
<tr>
<td>7</td>
<td>Hamburg</td>
<td>5.00</td>
<td>127,000</td>
<td>37.6%</td>
<td>25.4</td>
</tr>
<tr>
<td>8</td>
<td>Stuttgart</td>
<td>5.20</td>
<td>122,000</td>
<td>45.6%</td>
<td>23.5</td>
</tr>
<tr>
<td>9</td>
<td>Hannover-Braunschweig-Göttingen</td>
<td>3.78</td>
<td>114,100</td>
<td>27.2%</td>
<td>30.0</td>
</tr>
<tr>
<td>10</td>
<td>Erlangen-Nuremberg</td>
<td>3.45</td>
<td>94,200</td>
<td>28.8%</td>
<td>27.3</td>
</tr>
<tr>
<td>11</td>
<td>Rhine-Neckar</td>
<td>2.31</td>
<td>84,900</td>
<td>43.0%</td>
<td>36.7</td>
</tr>
<tr>
<td>12</td>
<td>Bremen-Oliverburg</td>
<td>2.72</td>
<td>58,800</td>
<td>19.1%</td>
<td>21.6</td>
</tr>
<tr>
<td></td>
<td>Metropolitan Regions Total</td>
<td>52.81</td>
<td>1,905,100</td>
<td></td>
<td>36.6</td>
</tr>
</tbody>
</table>
### 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><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>100%</strong></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><strong>Total</strong></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, 2013

- 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>30.4</td>
</tr>
<tr>
<td>Munich (City)</td>
<td>27.1</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>20.2</td>
</tr>
<tr>
<td>Cologne</td>
<td>19.1</td>
</tr>
<tr>
<td>Essen</td>
<td>15.7</td>
</tr>
<tr>
<td>Dortmund</td>
<td>13.8</td>
</tr>
<tr>
<td>Germany</td>
<td>13.2</td>
</tr>
<tr>
<td>Bochum</td>
<td>13.2</td>
</tr>
<tr>
<td>Duisburg</td>
<td>11.2</td>
</tr>
</tbody>
</table>

Data and map: BBSR 2016

Education of Employees, 2000 & 2011

<table>
<thead>
<tr>
<th>Region</th>
<th>2000</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>18%</td>
<td>10%</td>
</tr>
<tr>
<td>NRW</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>The Ruhr</td>
<td>14%</td>
<td>11%</td>
</tr>
</tbody>
</table>
Universities: Impacts on Regional Economies

- **Value added, employment, income**
  - Income multiplier
  - Tax revenue
- **Demand** for goods and services
  - Input multiplier

- Production of basic knowledge through **research**
- **Education** of highly-skilled personnel
- **Image effects**
  - Attraction/retention of firms and human capital
- **Structural effects**
  - e.g. the Ruhr: Structural change manufacturing ⇒ services; knowledge economy
- **Knowledge and Technology Transfer (KTT)**

---

**RUB: Selected Figures**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students (WS 2015/2016)</td>
<td>43,004</td>
</tr>
<tr>
<td>Employees (31.12.2015)*</td>
<td>ca. 5,655</td>
</tr>
<tr>
<td>- of which (junior) professors</td>
<td>466</td>
</tr>
<tr>
<td>Revenue (2015)</td>
<td>€ 539.1 m</td>
</tr>
<tr>
<td>- of which third-party funding</td>
<td>€ 114.8 m</td>
</tr>
</tbody>
</table>

---

**KTT through Universities**

- **Contract research** for firms
- **Research co-operations** with firms
- **Education** of highly-skilled personnel for firms (incl. executive education)
- **Commercialisation** of research results through
  - **Patents and licences**
  - New firm foundation (**Spin-offs**) by faculty, graduates and students
Antenna Function of Universities

- Universities **absorb** knowledge through interregional and international research co-operations.
- Universities **distribute** knowledge into the regional economy.

Cf. Fritsch/Schirrman 1998

Example: Study

The Ruhr – A Science-based Metropolis?

<table>
<thead>
<tr>
<th>Relevance</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 260,000 university students</td>
<td>• Only 12 non-university research institutes (Berlin-Brandenburg: 39; Munich: 22), esp. too few Max Planck &amp; Fraunhofer</td>
</tr>
<tr>
<td>• 1,500 university professors</td>
<td>• Worst student-professor ratio in the country: 66 students per professor (Bremen-Oldenburg: 44, Munich: 54)</td>
</tr>
<tr>
<td>• Direct &amp; indirect employment effect of 50,000</td>
<td>• 400 more professors needed to reach average ratio</td>
</tr>
<tr>
<td>• Demand effect of € 2.3 bn p.a. through universities incl. their employees and students</td>
<td>• Low levels of third-party funding per professor (cf. Barthold et al. 2016, p. 76)</td>
</tr>
</tbody>
</table>

Cf. Kriegesmann et al. 2015
New Firm Formation

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

<table>
<thead>
<tr>
<th>Region</th>
<th>NFF per 10,000</th>
<th>Change over 2005/2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>36.6</td>
<td>-11.1%</td>
</tr>
<tr>
<td>West Germany</td>
<td>37.4</td>
<td>-9.7%</td>
</tr>
<tr>
<td>NRW</td>
<td>36.4</td>
<td>-10.4%</td>
</tr>
<tr>
<td>The Ruhr</td>
<td>34.3</td>
<td>-10.8%</td>
</tr>
</tbody>
</table>

- Formation rate typically below average in regions with early industrialisation
- The Ruhr lagging behind only slightly, but...

Data: Arndt et al. 2015, p. 69

Knowledge-intensive NFF

Arndt et al. 2015, p. 70

Ruhr Lecture: Structural Change in the Ruhr – Towards a Knowledge-based Economy?
University-based Entrepreneurship (Spin-offs)

EXIST entrepreneurship grants, 2007-2015

<table>
<thead>
<tr>
<th>City</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>204</td>
</tr>
<tr>
<td>Munich</td>
<td>99</td>
</tr>
<tr>
<td>Dresden</td>
<td>57</td>
</tr>
<tr>
<td>The Ruhr</td>
<td>40</td>
</tr>
<tr>
<td>Potsdam</td>
<td>38</td>
</tr>
<tr>
<td>Karlsruhe</td>
<td>37</td>
</tr>
<tr>
<td>Aachen</td>
<td>35</td>
</tr>
<tr>
<td>Stuttgart</td>
<td>34</td>
</tr>
<tr>
<td>Köln</td>
<td>29</td>
</tr>
<tr>
<td>Hamburg</td>
<td>24</td>
</tr>
<tr>
<td>Bremen</td>
<td>19</td>
</tr>
<tr>
<td>Darmstadt</td>
<td>18</td>
</tr>
</tbody>
</table>

Data: Kriegesmann et al. 2015, p. 47

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Cultural and Creative Economy

Germany 2014
- Ca. 1.6 Mio. employees
- 2.7% of total employment
- 2.3% of GVA
(BMWi 2016, p. 13)

BMWi 2016, p. 12
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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 (2013)**

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

<table>
<thead>
<tr>
<th>County/City</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gilhorn</td>
<td>13.0</td>
</tr>
<tr>
<td>Munich (City)</td>
<td>8.8</td>
</tr>
<tr>
<td>Cologne</td>
<td>8.0</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>5.4</td>
</tr>
<tr>
<td>Essen</td>
<td>4.2</td>
</tr>
<tr>
<td>Dortmund</td>
<td>4.1</td>
</tr>
<tr>
<td>Bochum</td>
<td>3.5</td>
</tr>
<tr>
<td>Duisburg</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Data and map: BBSR 2016
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

Flagship Approach to CCE Development

- Dortmunder U
  - 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. Maier-Solgik 2012, Laurin 2013)

- Design at Zollverein
  - Ca. 40 firms with > 950 employees (WAZ 2013, Schümann 2014)
  - Folkwang University of the Arts to open in 2017
  - Creative class prefers authentic urban quarters (Essen: Rüttenscheid, Nordstadt)
The Ruhr in the Knowledge Economy: Summary

- Universities established as engines of structural change, but primarily through **education**
  - Rapidly rising student numbers
  - Poor endowment (student-professor-ratio)
- Knowledge economy underdeveloped & lack of **innovation capacity** in the business sector
  - Low absorptive capacity for university graduates in the labour market
  - Net export of university graduates (brain drain)
- Barriers to **entrepreneurship** and spin-offs
- **Creative economy** hyped as panacea
  - Lagging quantitatively
  - Thriving bottom-up in selected places and sub-sectors

Outline

1) Structural Change in the Ruhr
2) Structural Change: Theoretical Explanations
3) Structural Change 2.0: Towards the Knowledge Economy
4) The Ruhr in the Knowledge Economy
5) **Challenges: The Case of Bochum**
Bochum’s Economic Transitions

<table>
<thead>
<tr>
<th>BOCHUM 1.0</th>
<th>BOCHUM 2.0</th>
<th>BOCHUM 3.0</th>
<th>BOCHUM 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial coal mining based on steam engine</td>
<td>Coal mining and steel industry (Bochumer Verein, later Krupp AG)</td>
<td>Attraction of manufacturing plants (Opel...) and acquisitions (e.g. Nokia) Foundation or RUB</td>
<td>Universities and research organisations UniverCity network Worldfactory Mix of small and large firms</td>
</tr>
</tbody>
</table>

Agrarian & mining city | Coal mining & steel city | City of Fordist mass production | Knowledge city |

19th century | until 1960s | from 1950s | 21st century |

UniverCity Bochum 2016, p. 17 (own translations); based on Wannöffel 2014

Employment* Growth, 2004-2012 (2004 = 100)

*) covered by social insurance

Data: IT-NRW 2013
Structural Change: Bochum Facing the Knowledge Economy

- **Erosion of large firms** (cf. Wannöffel 2014)
  - Coal mines and steel works
  - Nokia (2008)
  - Opel (2014)
  - Outokumpo stainless steel mill (2015)
  - ThyssenKrupp steel (e.g., closure of railway engineering section)

- **Largest employers** today
  - Ruhr University
  - University hospitals
  - City (administration, subsidiaries)
  \[\Rightarrow\] each ~ 6,000 staff
Structural Change: Bochum Facing the Knowledge Economy

- New Profile as a location for science, education and healthcare
  - Integration of universities and urban development
    - Masterplan University-City (2009)
    - UniverCity network (*2011), science city framework concept (Tata 2014)
  - Health Campus
  - New spillovers from research (geothermal energy, IT security), but economic impact still limited.

http://www.derwesten.de/img/incoming/cropd9808706/191860734/size927_543-w656-h240/Bochum
gesundheitscampus.jpg (17.10.2014)

Stadt Bochum 2009, p. 36

- Universities ⇒ education, entrepreneurship ⇒ 15,000 new manufacturing jobs for Bochum and the region in the medium term?! (Wannöffel 2014)

- RUB & labour union IGM: Project on knowledge-based urban development (“Bochum 4.0”)
  - Core: transdisciplinary concept for education and entrepreneurship linking universities, businesses, public administration and associations = Worldfactory

RUB 2014, p. 6
Worldfactory: Challenges

- Investment of ca. € 100 m expected
  - Lack of entrepreneurial culture in university
  - GUESSS: RUB student with low propensity to start firms
  - Locational competition (cf. New RWTH Aachen campus with 19 'research clusters')

- Mark 51°7 ⇒ Science hub conflicting with official flexible & pragmatic strategy (mixed commercial use incl. logistics – DHL)
  - Pressure to develop site
  - Lack of vision and commitment to long-term concepts

Left: http://www.archwerk.org/de/project/109 worldfactory#0 [20.10.2015]
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Entrepreneurial Potential @ RUB: Empirical Evidence

Global University Entrepreneurial Spirit Students’ Survey (GUESSS) 2013/2014: Entrepreneurial intentions and activities of university students in Germany

<table>
<thead>
<tr>
<th>Indicator</th>
<th>RUB rank</th>
<th>Out of...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students already entrepreneurs or freelancers</td>
<td>11</td>
<td>29</td>
</tr>
<tr>
<td>Entrepreneurial Intentions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Economics</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>- Philology, cultural and social sciences</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>- Engineering and computer sciences</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>- Mathematics and natural sciences</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Attendance of entrepreneurship classes</td>
<td>25</td>
<td>29</td>
</tr>
<tr>
<td>Entrepreneurial climate</td>
<td>29</td>
<td>29</td>
</tr>
</tbody>
</table>

NB: Undergraduate students in first two years of programme not surveyed in Bochum
Cf. Bergmann 2014

Context Effects: Neighbourhood Matters!

- Proximity of Dortmund
  - Backwash effects through first mover advantages and agglomeration effects (positive externalities)
# Knowledge Infrastructures: Bochum vs. Dortmund

## Bochum vs. Dortmund

<table>
<thead>
<tr>
<th>Bochum</th>
<th>Dortmund</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Innovation Centres &amp; Technology Parks</strong></td>
<td><strong>Innovation Centres &amp; Technology Parks</strong></td>
</tr>
<tr>
<td>Technologiezentrum Ruhr (*1989, 16,500 m²)</td>
<td>TZDO (*1985, 103.395 m²)</td>
</tr>
<tr>
<td>Technologiequartier (*1995, 12 ha)</td>
<td>TPDO (*1985, 40 ha)</td>
</tr>
<tr>
<td><strong>Case Study: Biomedical R&amp;D</strong></td>
<td><strong>Case Study: Biomedical R&amp;D</strong></td>
</tr>
<tr>
<td>BioMedizinZentrum Bochum (*2009, 5,200 m²)</td>
<td>BioMedizinZentrum Dortmund (BMZ I &amp; II: *2002/2005, 15,000 m²)</td>
</tr>
<tr>
<td>BioMedizinPark (*2006, 5,5 ha – now Gesundheitscampus Süd)</td>
<td></td>
</tr>
</tbody>
</table>

TZDO: Gross floor space

## Context Effects: Neighbourhood Matters!

- **Proximity of Dortmund**
  - Backwash effects through first mover advantages and agglomeration effects (positive externalities)

- **Strategic alternatives for Bochum**
  - Regional Cooperation with complementary concepts (division of labour, functional specialisation)
  - Differentiation through novel/unique concepts, z.B. Worldfactory
  - Cooperative competition (Cooperation, Brandenburger/Nalebuff 2013)
Vision: The Ruhr as a Networked Knowledge Region

Reicher et al. 2011, p. 255

Knowledge Economy: Dimensions and Strategies

Own representation, drawing on Toh et al. 2002, Romer 1993
What Should Be Done?

- Differentiated, objective analysis instead of euphoria or misery
- Structural change well-advanced, but left scars underneath the surface
  - Human capital: Socio-spatial polarisation and groups with little access to (higher) education ⇒ Promote social mobility through programmes such as ‘Talent Scouts’
  - Lack of innovative and entrepreneurial capacity, little business-sector R&D
- Culture of subsidisation ⇒ help for self-help
  - Endogenous potential
  - Parochial thinking (‘Kirchturmdenken’) ⇒ Co-operation on specific issues
  - Civic engagement and corporate regional responsibility
- Universities and research organisation are potential engines for a regional knowledge economy, but their economic impact is still held back by
  - Negative brain-flow balance (brain drain)
  - Entrepreneurial culture and climate (universities and regional level)
  - Lack of linkages with businesses, esp. SME
  ⇒ Potential for strengthening the manufacturing core (SMES, e.g. digitalisation – „Industrie 4.0“)

Population, 1995-2013

Arndt et al. 2015, p. 34
Components of Population Growth, 1995-2013

- Births minus deaths
- Migration balance

References (1/7)


References (2/7)


References (3/7)


References (4/7)


References (5/7)


References (6/7)


References (7/7)


