The slowdown of German productivity growth

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Steffen Elstner, Lars P. Feld and Christoph M. Schmidt
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Outline

1. Motivation
2. The effects of German labor market reforms on productivity
3. An end to outsourcing in German manufacturing
4. Digitization and productivity (Industry 4.0)
5. Conclusion
1. Motivation
Facts about the German economy

• **fourth largest economy** of the world:
  - Share in world GDP (US-Dollar, 2016): 4.6%
  - U.S. (24.7%), China (15.1%), Japan (6.3%), U.K. (3.5%) and Italy (2.5%)

• very **export-oriented**: export share roughly 47% of GDP
  - Germany’s share in world merchandise exports of 2015 was 8.1% (WTO)
  - U.S. (9.1%), China (13.8%), Japan (3.8%), U.K. (2.8%) and Italy (2.8%)

• high importance of **manufacturing** (roughly 23% in GVA)
• relatively **high level of labor productivity**
Major challenge: demographic change

- Labor force will decline in the future; in particular, in innovative professions.
- Acceptance of new business models will tend to decline as societies age (technology diffusion).
Importance of labor productivity growth

- in last decades GDP growth primarily driven by productivity growth
- since the year 2005 the picture has changed
Since the mid-2000s: weak labor productivity growth in almost all industrial countries

Labor productivity per hours worked in selected countries

- no productivity growth in Italy; „ICT revolution“ in the US; recovery in productivity growth in Spain
Differences between manufacturing and service sectors (results obtained with HP-filter)

- **manufacturing**: high TFP, low investment
- **service sectors**: low TFP, robust investment
2. The effects of German labor market reforms on productivity
Key terms and relationships

- labor productivity: highly complex variable with a large number of influencing factors

\[ \Delta \ln y_t = \alpha \Delta \ln k_t + (1 - \alpha) \Delta \ln E_t + \Delta \ln A_t \]

- \( k_t \): **capital deepening**/ capital services per hour/person
- \( E_t \): **average labor quality** per hour/person
- \( A_t \): **total factor productivity** (innovation activity)

- not mentioned: outsourcing, dismissing productivity, intensity of competition and so on.
Definition composition effect

- increase in employment by roughly 3.4 million persons between the years 2005 and 2014
  - successful integration of less-qualified workers into the labor market
  - decline in average productivity per employed person (composition effect, effect on average labor quality)

- **side effect of successful reforms**

Effect becomes visible by the following developments:

1. structural shift towards specific service sectors (reallocatation effect)
2. sector-specific effects within these sectors
Strong increases in employment: trade, accommodation, health services and personnel leasing
Decomposition of labor productivity

decompose aggregate labor productivity into:
1. within sector specific effects (1. term, right side)
2. reallocation effect (2. term, right side)

\[
\left( \frac{AP_t - AP_0}{AP_0} \right) = \sum_{i=1}^{N} \left( \frac{AP_t^i - AP_0^i}{AP_0} \right) n_0^i + \sum_{i=1}^{N} (n_t^i - n_0^i) \frac{AP_t^i}{AP_0}
\]
Since the early 2000s the growth contribution of the reallocation effect on labor productivity was negative.

![Graph showing labor productivity and accumulated growth contributions to labor productivity since 1995.](chart.png)
# Growth contributions to aggregate labor productivity

Percentage points

<table>
<thead>
<tr>
<th>Within sector-specific growth contributions</th>
<th>Share(^1)</th>
<th>Per person employed</th>
<th>Per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>22.4</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Service sector</td>
<td>69.8</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>including:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Wholesale and retail trade, repair of motor vehicles, transport and storage, accommodation</td>
<td>16.5</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Information and communication</td>
<td>4.6</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Professional, scientific and technical activities</td>
<td>6.3</td>
<td>– 0.2</td>
<td>– 0.1</td>
</tr>
<tr>
<td>Administrative and support service activities</td>
<td>4.3</td>
<td>– 0.1</td>
<td>– 0.1</td>
</tr>
<tr>
<td>Human health and social work activities</td>
<td>6.6</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Reallocation effect</td>
<td>0.1</td>
<td>– 0.2</td>
<td></td>
</tr>
</tbody>
</table>

### Development of labor productivity (%)

| Actual development\(^2\) | 1.1 | 0.4 | 1.9 | 0.8 |
| Development without structural shifts\(^3\) | 0.9 | 0.7 | 1.6 | 1.0 |

1 – Share of the corresponding sector in total gross value added in the year 2005. 2 – Average annual change of total gross value added per person employed and per hour, respectively. 3 – Without the reallocation effect. Difference in total due to rounding.
3. An end to outsourcing in German manufacturing
Growth contributions: labor productivity in manufacturing sector (output per hour)

- Adjustment of total hours worked played an important role
• no clear link between labor productivity growth and the change of the capital stock
• important role for research and development
Productivity gains through outsourcing

- change in production value can be written as follows:
  \[ \Delta \ln PW_t = \Delta \ln A_t + \alpha \Delta \ln K_t + \beta \Delta \ln VL_t + (1 - \alpha - \beta) \Delta \ln L_t \]

- link between production value and value added:
  \[ \Delta \ln PW_t = \gamma \Delta \ln Y_t + \beta \Delta \ln VL_t \]

- change in value added is then:
  \[ \Delta \ln Y_t = \frac{1}{\gamma} \Delta \ln A_t + \frac{\alpha}{\gamma} \Delta \ln K_t + \frac{(1 - \alpha - \beta)}{\gamma} \Delta \ln L_t \]

- \[ \frac{1}{\gamma} \Delta \ln A_t \] denotes measured tfp and \[ \Delta \ln A_t \] is purified tfp (“technological progress“)
### Growth contributions to labour productivity in selected sectors of manufacturing

#### Percentage points

<table>
<thead>
<tr>
<th>Share</th>
<th>Per person employed</th>
<th>Per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>2.7</td>
<td>1.1</td>
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</table>

**Within sector-specific growth contributions**

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<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Vehicle production</td>
<td>17.1</td>
<td>0.2</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Machinery</td>
<td>14.7</td>
<td>0.2</td>
<td>– 0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Electrical equipment</td>
<td>7.1</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Computer, electronic and optical products</td>
<td>6.6</td>
<td>0.9</td>
<td>0.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Metal production and metal products</td>
<td>13.1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Chemical products</td>
<td>7.6</td>
<td>0.4</td>
<td>– 0.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**Reallocation effect**

<p>| | | | | |</p>
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<tbody>
<tr>
<td>– 0.1</td>
<td>0.1</td>
<td>– 0.0</td>
<td>0.0</td>
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</tr>
</tbody>
</table>

**Actual development %**

|--------------------|-------------|-------------|-------------|-------------|
| – Share of the corresponding sector in total gross value added of manufacturing in the year 2005. 2 – Average annual change of real gross value added per person employed and per hour worked, respectively.

1 – Share of the corresponding sector in total gross value added of manufacturing in the year 2005. 2 – Average annual change of real gross value added per person employed and per hour worked, respectively.
Depth of production (vertical integration) does not decline anymore.
Important: Relocation abroad

Value added, production value and intermediate goods

Log. scale 1991 = 100

Share of intermediate goods in production value

Source: Federal Statistical Office
4. Digitization and productivity (Industry 4.0)
Growth Accounting

• update of the analysis done by Eicher und Röhn (2007)
• use of the ifo Investment Database
• at the industry level (industry i):

\[ \Delta \ln y_i = v_i^{ICT} \Delta \ln k_i^{ICT} + v_i^{NICT} \Delta \ln k_i^{NICT} + v_i^L \Delta \ln E_i + \Delta \ln A_i \]

• consideration of the following groups:
  1. ICT-producing sectors (roughly 5% of total value added)
  2. ICT-intensive sectors (roughly 40% of total value added)
  3. other sectors (roughly 55% of total value added)
ICT productivity paradox in service sectors

Comparison of the contributions to labor productivity and total factor productivity between Germany and the United States

Paradox: no clear positive link between ICT-investment and “genuine“ productivity gains in ICT-intensive sectors
Paradox: Difference to the US

- paradox only exists in service sectors
- Bloom, Sadu und van Reenen (AER, 2012):
  - complementary factors (e.g. firm structure and organisation)
    - regulation factor- and product markets (competition)
    - human capital
    - firms are not successful in implementing ICT-investments efficiently (e.g. due to demographic change)
  - quality of management (remuneration systems, promotions, “hire and fire“)
- demographic change
Industry 4.0

- digitization and networking of the value added chains in manufacturing with ICT
- increase in total factor productivity:
  - elimination of rising returns to scale; declining set up costs for special productions
  - new product innovations induced by better data
  - provision of new services by producer
- professions, workplaces and products come under pressure (industrial revolution)
5. Conclusion
Summary

1. dampening „composition effect“ of successful labor market reforms at the beginning of the 2000s
2. manufacturing: outsourcing process seemingly over
3. no productivity enhancing impulses from the ICT-intensive sectors
4. important role for education and training, teaching of necessary IT-skills
5. against a too strong regulation of labor and goods markets, in particular, in several service sectors
6. financing of start-ups: Removing distortions instead of creating new subsidies (invest grant)
6. Appendix
64 % of total R&D investment is done by manufacturing, weaker development of R&D in small and medium businesses