Outline

1. Facts: Polarization in the labour markets
2. Theory: Biased technical change
3. Empirics: Routine-biased technological change
4. Policy issues
Stylized fact: Polarization in the labour markets

**Wage “polarization”**
- Relative wage growth for upper- and lower-tail of wage distribution over the last two decades.

**Job “polarization”**
- During the same period, there has been an increase in well-paid skilled jobs and in low-paid least-skilled jobs, and a decrease in the “middling” jobs.

**Empirics**
- For the UK: Goos and Manning (2007)
- For Germany: Spitz-Oener (2006); Dustmann *et al.* (2009)
- For 16 Western European countries: Goos *et al.* (2009); Michaels *et al.* (2014)
- For Japan: Ikenaga (2009); Ikenaga and Kambayashi (2016)
European countries

Goos et al. (2009)

- Job polarization in 16 European countries between 1993 and 2006.
- The high- and low-paying occupations (measured by their 1994 log wage) increase their employment shares, whereas the occupations paying close to the mean wage decrease their employment share.


*Source:* Goos et al. (2009), Figure 1.

Source: Ikenaga and Kambayashi (2016), Figure 1.

Ikenaga and Kambayashi (2016)

- There is a decline of middle-paid occupations and maintenance of employment in lowest-paid occupations, whereas employment growth was mainly induced by the highest-paid occupations.
Technical Change and wage inequality: SBTC

• The relative demand for skills is linked to the skill bias of technical change.

• The Skill-Biased Technical Change (SBTC) hypothesis…
  • predicts that demand for “skilled” jobs is rising relative to that for “unskilled” jobs → Wage growth depending on skill level
  • could explain a rapid growth in wage inequality during the 1980s, especially between college graduates and non-college graduates.

• However, the SBTC hypothesis cannot explain the growth in wage and demand for low wage occupation, which was observed in the last two decades.
Technical Change: Task-based framework

• Acemoglu and Autor (2011)
  • A task: a unit of work activity that produces output (occupation)
  • A skill: worker’s endowment of capabilities for performing various tasks (education)
  • Skills applied to tasks produce output.

• Autor, Levy and Murnane (2003)
  • Technological developments have enabled information and communication technologies (ICT) to perform the core job tasks previously performed by middle skill workers, thus causing a substantial change in the returns to certain types of skills and a measurable shift in the assignment of skills to tasks.
# Task measures (by O*NET in the US)

<table>
<thead>
<tr>
<th>i. Abstract</th>
<th>1. Analytical</th>
<th>Analyzing data/information, Thinking creatively, Interpreting information for others</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Interpersonal</td>
<td>Establishing and maintaining personal relationships, Guiding, directing, and motivating subordinates, Coaching and developing others</td>
</tr>
<tr>
<td>ii. Routine</td>
<td>3. Cognitive</td>
<td>Importance of repeating the same tasks, Importance of being exact or accurate, Structured versus unstructured work</td>
</tr>
<tr>
<td></td>
<td>4. Manual</td>
<td>Controlling machines and processes, Keeping a pace set by machinery or equipment, Time spent making repetitive motions</td>
</tr>
<tr>
<td>iii. Nonroutine</td>
<td>5. Manual</td>
<td>Operating vehicles, mechanized devices, or equipment, Time spent using hands to handle, control, or feel objects, tools, or controls, Manual dexterity, Spatial orientation</td>
</tr>
</tbody>
</table>

Source: Autor and Handel (2013), Appendix
Routine task intensity in 16 European countries, 1993-2010

<table>
<thead>
<tr>
<th>High-paying occupations e.g. managers, engineers</th>
<th>Average employment share in 1993 (%)</th>
<th>% point change 1993-2010</th>
<th>Routine Task Intensity (RTI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middling occupations e.g. office clerks, craft and related trade workers</td>
<td>46.75</td>
<td>-9.27</td>
<td>0.69</td>
</tr>
<tr>
<td>Low-paying occupations e.g. sales persons, service persons</td>
<td>21.56</td>
<td>3.65</td>
<td>-0.08</td>
</tr>
</tbody>
</table>

Note: RTI = ln(R) − ln(M) − ln(A) where R, M, and A are occupation-level measures for routine, manual, and abstract tasks derived from the Dictionary of Occupational Titles (DOT) 1977.
Source: Goos et al. (2014), Table 1

**Routine task intensity (RTI)** is high for middling occupations, which deceased their employment share between 1993 and 2010.
Trends in task input in Japan, 1960-2005

Share of routine task input in occupations has declined over the past five decades in Japan

Source: Ikenaga and Kambayashi (2016), Figure 2
There is a shift in relative demand away from occupations that are more routine → "Routine-biased technological change" (RBTC)

Sources of job polarization: Europe

<table>
<thead>
<tr>
<th>Linear time-trend interacted with:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT1</td>
<td>-0.900***</td>
<td>-0.888***</td>
<td>-0.866***</td>
<td>-0.868***</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.126)</td>
<td>(0.135)</td>
<td>(0.141)</td>
<td>(0.129)</td>
<td>—</td>
</tr>
<tr>
<td>Offshorability</td>
<td>-0.013</td>
<td>-0.005</td>
<td>-0.006</td>
<td>—</td>
<td>-0.383**</td>
</tr>
<tr>
<td></td>
<td>(0.159)</td>
<td>(0.175)</td>
<td>(0.180)</td>
<td>—</td>
<td>(0.165)</td>
</tr>
<tr>
<td>log industry marginal costs</td>
<td>—</td>
<td>0.854***</td>
<td>0.895***</td>
<td>0.895***</td>
<td>0.899***</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>(0.145)</td>
<td>(0.161)</td>
<td>(0.161)</td>
<td>(0.161)</td>
</tr>
<tr>
<td>log industry output</td>
<td>—</td>
<td>0.142**</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>(0.061)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>48,139</td>
<td>44,062</td>
<td>44,062</td>
<td>44,062</td>
<td>44,062</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.954</td>
<td>0.947</td>
<td></td>
<td></td>
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</tbody>
</table>

Source: Goos et al. (2014), Table 3.
Sources of job polarization: Japan

Real non-ICT capital stock have replaced routine labour task, and **ICT capital reinforces the tendency.**
Summary

• In Europe (Goos et al. 2009)
  • Technologies are becoming more intense in the use of nonroutine tasks concentrated in high-paid and low-paid service jobs, at the expense of routine tasks concentrated in manufacturing and clerical work.

• In Japan (Ikenaga and Kambayashi 2016)
  • Since the 1980s, the introduction of ICT capital probably accelerated both the increase in nonroutine task inputs and the decrease in routine task inputs.
Remaining issues: other aspects of wage differentials

Wage differentials within groups
• **College major**: growth in **returns to abstract task** explained the increase in wage inequality across college majors
  • For Japan, 1995-2005 (Maeda, 2016)

Wage differentials between groups
• **Gender**: A relative **decline in routine task inputs** and a relative **increase in abstract task inputs** among women explain a substantial fraction of the closing of the gender wage gap in West Germany (Black and Spitz-Oener 2010)
Remaining issues: Job tasks and workers’ characteristics: Case of Japan

Data
• A web-based survey conducted by our research team in March 2016.

Sample
• Employed persons those who are 18 years old and over at survey date.

Number of observations
• 1,557 for whole sample → 720 for full-time and permanent employees under 60 years old

Task measures: Abstract, Routine and Manual
• are based on the O*NET questionnaire, described in Autor and Handel (2013).
• All three task measures are standardized to have a mean of 0 and a standard deviation of 1.
## Descriptive regressions for Task intensity

<table>
<thead>
<tr>
<th></th>
<th>strict</th>
<th>Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td>(3)</td>
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<tr>
<td>(2)</td>
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<td>(4)</td>
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<tr>
<td>(5)</td>
<td></td>
<td>(6)</td>
</tr>
</tbody>
</table>
Implications

Tentative results

• The intensity of **Abstract task** for an individual job mainly depends on **occupations**, while females’ low use of Abstract tasks persists after controlling for human capital and occupation.

• As for **routine task and non-routine manual task**, measures of human capital—in particular, **higher education and years of experience**—are significant predictors of within- as well as between-occupation variation in job tasks.

Importance of human capital investment

• Higher education → Education policy

• Job training → Active labor market policy
References


References (Cont.)


