Technology and Labour Markets

Carl Benedikt Frey
The declining cost of computers
Is this time different?

U.S. Civilian Labour Force Participation Rate

Untangling Trade and Technology

Autor, Dorn and Hanson (2015):

- Chinese import competition has caused unemployment and non-employment
- Automation has caused job polarization and growing wage disparities

Cortes, Jaimovich and Sui (2016):

- Unemployment and non-employment among low skilled routine workers
Job polarization in advanced economies

Source: David Autor (2010), “The Polarisation of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings,” Center for American Progress and The Hamilton Project. Wage categories are based on average wage levels at the start of the period measured.
Job polarization in developing economies

- High-skilled occupations (intensive in nonroutine cognitive and interpersonal skills)
- Middle-skilled occupations (intensive in routine cognitive and manual skills)
- Low-skilled occupations (intensive in nonroutine manual skills)
The end of industrialization?

Manufacturing employment share in peak year vs. GDP p.c. in peak year (ln)

- ARG (1958)
- SWE (1961)
- KOR (1989)
- ITA (1980)
- FRA (1974)
- USA (1953)
- CHL (1954)
- JPN (1969)
- ESP (1975)
- MEX (1980)
- GHA (1978)
- COL (1970)
- PER (1971)
- IND (2002)
- NGA (1982)
- ZMB (1985)
The expanding comparative advantage of computers

**Human computers** performing mathematical calculations

"The human computer is supposed to be following fixed rules; he has no authority to deviate from them in any detail." (Turing, 1950)

**Electronic computers** performing routine tasks:

- Calculation
- Repetitive customer service
- Picking or sorting
- Repetitive assembly

**Machine learning algorithms** performing non-routine tasks:

- Medical diagnostics
- Document review
- Translation
- Driving
Where will human workers still hold the comparative advantage?

Creativity

Social intelligence

Perception and manipulation
Who gains from technological progress?
The exposure of low-income jobs

Source: Bureau of Labor Statistics; Frey and Osborne (2013); CEA calculations.
Who gains from technological progress?

The exposure of low-income countries

Note: For Angola and Malta 2013 GDP per capita figures were used, Citi Research
The falling costs of automation

Source: Citi Research

The payback period is based on the cost of the robot system, average wages for metal manufacturing (for China and Thailand average manufacturing wages were used) and replacement labour based on 2 shifts. The costs also take into account a 5% additional potential savings through reduced staff welfare costs, optimised energy consumption, increased throughput and reduced wages.
Who gains from technological progress?

The exposure of low-income countries
Who gains from technological progress?

Past and present patterns of automation

Exposure to automation

Routine share

Exposure to offshoring

Source: Berger & Frey (2014)
Who gains from technological progress?

The growing regional divide
Who gains from technological progress?

New jobs cluster in skilled cities...

... and they have a multiplier of around 5 (Moretti, 2010)
Who gains from technological progress?

New jobs, but only for the highly skilled

<table>
<thead>
<tr>
<th>Detailed industry (examples)</th>
<th>% of US Employment</th>
<th>% with college degree</th>
<th>Avg. Wages ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet publishing and broadcasting</td>
<td>0.06</td>
<td>69.6</td>
<td>81,138</td>
</tr>
<tr>
<td>Electronic shopping</td>
<td>0.08</td>
<td>49.7</td>
<td>45,372</td>
</tr>
<tr>
<td>Data processing, hosting, and related services</td>
<td>0.08</td>
<td>48.0</td>
<td>64,729</td>
</tr>
<tr>
<td>Electronic auctions</td>
<td>0.01</td>
<td>52.2</td>
<td>47,257</td>
</tr>
</tbody>
</table>

0.5 % of the US workforce is employed in new industries created since 2000

Summary

- Automation has (and is likely to continue to have) negative impacts on certain skill groups.
- The impacts of automation are seemingly distinct from those of trade (although hard to disentangle).
- There is so far little evidence on that automation has had any impact on the aggregate demand for jobs.
- There is pervasive evidence that technology has had impacts on the growing regional divide.
- Technology has seemingly not been a key driver of job creation directly (although indirectly).