The Impact of Technology on the Labor Market

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Will there be any jobs left in the future?

Two common views

(1) “There will be jobs, but there will also be disruption, and inequality may rise.”

(2) “There won’t be jobs, except for a small minority of very skilled people.”

Our experience so far strongly supports (1). Is this time different?
Outline

Biased technological change in the past half century

Speculations on the future of labor markets
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Speculations on the future of labor markets
The price of computing

![Graph showing the progress of computing measured in cost per computation per second deflated by the price index for GDP in 2006 prices.](image)

**Figure 3**

THE PROGRESS OF COMPUTING MEASURED IN COST PER COMPUTATION PER SECOND DEFLATED BY THE PRICE INDEX FOR GDP IN 2006 PRICES
The price of robot labor

![Graph showing the price of robot labor over years for different countries. The x-axis represents the years from 1990 to 2005, and the y-axis represents the unit price of robots, quality-adjusted. The graph includes lines for the mean, US, Germany, Italy, Sweden, and the UK, showing a downward trend in the price of robots over time.]
What is the impact on the labour market? Think in terms of tasks


- Which tasks are taken over by computers/machines?
- What types of worker did previously perform these tasks?
- Are the tasks now done by computers important inputs/complements to the tasks done by remaining workers?

Which workers?

**Example**: analytical thinking as performed by consultants or investment bankers requires numerical calculations, which used to be done by humans, now done by computers
What is the impact on the labour market? Don’t forget firms’ incentives

Knowing what computers/machines can do is not sufficient for predicting which tasks will be automated—in some cases automation is feasible, but not economical.

Some low-skill work could in principle be automated but is not (yet) at all, or not (yet) on large scale

- cooking fast food
- cleaning
- simple forms of hairdressing
Which tasks will be automated?  
Framework by Feng & Graetz (2016)

Two things should matter for the automation decision: a task’s **engineering complexity** and whether human workers require **training** to perform it—these two are not perfectly correlated.

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Innate ability</th>
<th>Training-intensive</th>
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</thead>
<tbody>
<tr>
<td><strong>low</strong></td>
<td>crushing rocks</td>
<td>bookkeeping</td>
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<td></td>
<td>fast food preparation</td>
<td>weaving</td>
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<td><strong>medium</strong></td>
<td>customer reception</td>
<td>pre-trial research</td>
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<td>driving a car</td>
<td>trading stocks</td>
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<td><strong>high</strong></td>
<td>child care</td>
<td>arguing a legal case</td>
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<td></td>
<td>event planning</td>
<td>designing fashion</td>
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</tbody>
</table>
What is to be explained: job polarization in Europe

Change in Occupational Employment Shares in Low, Middle, and High-Wage Occupations in 16 EU Countries, 1993–2010

Source: Goos, Manning, and Salomons (2014, table 2).

Source: Autor (2015)
What is to be explained: polarization in the US

Panel A. Smoothed changes in employment by skill percentile, 1980–2005

Source: Autor & Dorn (2013)
What is to be explained: polarization in the US, pre-ICT

Source: Barany & Siegel (2014)
Taking the task approach to the data

Approach pioneered by Autor et al. (2003)

- use survey data on occupational task content: Dictionary of Occupational Titles, ONET

- for each occupation, quantify variables that should matter for automation decision

Here: for 260 occupations, measure their training requirements and engineering complexity in 1980
Employment growth by initial job complexity

Change in log of hours worked, 1980-2008

Complexity (standardized), 1980
Employment growth by initial training requirements

Change in log of hours worked, 1980-2008 vs. Training time in months, 1980.
Accounting for job polarization in the US

- statistical model that relates occupational employment growth to initial training requirements and complexity
- use model to predict the 2008 distribution of employment across occupations that is due to training and complexity
- compute predicted changes in employment shares
- compare to actual changes
Accounting for job polarization in the US

![Graph showing employment share change from 1980 to 2008 with skill percentiles ranked by 1980 occupational mean wage. The graph compares actual employment share changes with predicted changes using Autor-Dorn model and training & complexity model.](image)
Another consequence of automation: some jobs get simpler

Occupations are bundles of tasks—firms selectively automate tasks within occupations

In US 1980-2008, among the occupations with the largest decreases in training requirements were

- air traffic controllers
- insurance adjusters
- precision workers

In general, occupations that initially had intermediate training requirements and low complexity, became simpler and saw their employment shares fall
Why job polarization is not unique to ICT

Suppose some general purpose technology—the electric motor, ICT—makes it easier to automate tasks in general. Which tasks will firms choose to automate?

- tasks that are less complex (though as technology improves, automate more-complex tasks)
- tasks where labor is expensive—e.g. because of training

Low-skill workers are shielded from automation—they are cheap, and often perform complex tasks, as are high skill workers—the tasks they perform are too complex to be profitably automated.

Middle skill workers are most likely to be replaced
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Frey & Osborne (2014) consulted engineers to find out which occupations are at risk of automation

▶ 47 percent of US employment at risk

▶ Arntz et al. (2016) take into account within-occupation task mix: 9 percent at risk

Important to remember: figures concern feasibility of automation. But profitability is another issue—need to consider cost of labor

Further reasons to take figures as an upper bound

▶ demand response to lower prices (Graetz & Michaels, 2015)

▶ creation of new tasks and jobs (Acemoglu & Restrepo, 2016)
Using the task approach to predict the future

Previously, high and low skill workers shielded from automation—will this still be the case?

▶ incentives still point to low skill work being secure

▶ important exception: driverless vehicles—only small amount of additional capital needed for automation

▶ high skill workers increasingly under threat, but benefit from creation of new tasks, and from need for management of messy adoption processes
Literature