Job transitions, labour divisions and automation: A networks perspective

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The division of labour is a key driver of productivity

The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity and judgment which it is anywhere directed, or applied, seem to be the effects of the division of labour”

Adam Smith, The Wealth of Nations, 1776
Specialising in different jobs increases output at an aggregate level.
But on an **individual** level...

We’re more **anxious** about our jobs than ever before
Robots might steal it
Climate policy might threaten it.
Or it might get off-shored
Overview

1) Job transitions and occupational mobility
2) Divisions in the US labour market
3) Potential impact of automation

➢ with Maria del Rio Chanona, Francois Lafond, Mariano Beguerisse & Doyne Farmer
Job transitions and occupational mobility
In economic models, we often assume labour is very flexible...
But this assumption isn’t very realistic
The occupational mobility network

Based on job transitions in the US over 2010-2017
The occupational mobility network

Nodes represent occupations

- Engineering technician
- Drafter
- Butchers
- Bakers
The occupational mobility network

Nodes represent occupations

Links represent how likely people are to switch from one occupation to another

- Engineering technician
- Drafter
The occupational mobility network

- Installation, maintenance & repair
- Management
- Architecture & engineering
- Computer and mathematical
- Life, Physical & Social Science
- Office & administrative support
- Healthcare
- Production
- Transportation & material moving
- Food preparation & serving
- Personal care & service
What influences job switching?
Occupations

Podiatrist
- Fabricate medical devices

Nurse
- Prescribe medical treatment

Police Officer
- Direct organizational operations

Tasks
Occupations

Podiatrist
- Fabricate medical devices

Nurse
- Prescribe medical treatment
- Direct organizational operations

Police Officer
- Investigate criminal matters
Occupational task similarity predicts future job transitions
...what you **do** at work matters
Task similarity better explains variance in job transitions than other O*NET variables

Comparison of strength of relationship between job transitions and occupational similarity measures based on different O*NET variables.
Divisions of labour
The occupational mobility network

- Installation, maintenance & repair
- Production
- Transportation & material moving
- Food preparation & serving
- Personal care & service
- Healthcare
- Management
- Architecture & engineering
- Computer and mathematical
- Life, Physical & Social Science
- Office & administrative support
What about automation?
47% of employment in the United States is at risk of automation

- Frey & Osborne (2017)
Occupation-specific risk estimates are useful, but...
Occupation-specific risk estimates are useful, but…
Occupation-specific risk estimates are useful, but…
Could we take a more holistic view?
Also at risk of automation
Also at risk of automation

Increased competition
Also at risk of automation

Increased competition
New agent-based model of the labour market

Frey & Osborne (2017) Automation Susceptibility Estimate

- Office & administrative support
- Life, Physical & Social Science
- Personal care & service
- Healthcare
- Construction & Extraction
- Transportation & material moving
- Food preparation & serving
- Architecture & engineering
- Computer and mathematical
- Management
- Installation, maintenance & repair
- Computer & mathematical
- High risk
- Low risk
Frey & Osborne (2017)
Automation Susceptibility Estimate

- High risk
  - Management
  - Installation, maintenance & repair
  - Transportation & material moving
  - Production
  - Personal care & service
  - Food preparation & serving

- Low risk
  - Construction & Extraction
  - Healthcare
  - Life, Physical & Social Science
  - Computer and mathematical management
  - Architecture & engineering

But automatability is not the whole story. Workers lose their job but can move easily in high demand but many workers available.

Statistical technician
Frey & Osborne (2017)  
Automation Susceptibility Estimate

High risk

Electrician

Low risk

Statistical technician

But automatability is not the whole story. Workers lose their job but can move easily. High demand but many workers available.
We simulate workers responding to changes in demand associated with Frey and Osborne’s automation predictions.
Restrictions in occupational mobility exacerbate unemployment impacts.

Job switching is restricted by Occupational Mobility Network.

Fully flexible labour force.
## Occupations assigned the same automation risk can have very different unemployment prospects

<table>
<thead>
<tr>
<th>Occupation</th>
<th>FO Automation Probability</th>
<th>% increase in long term unemployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>shipping and traffic clerks</td>
<td>0.98</td>
<td>133.36</td>
</tr>
<tr>
<td>parts salespersons</td>
<td>0.98</td>
<td>119.36</td>
</tr>
<tr>
<td>library technicians</td>
<td>0.99</td>
<td>116.21</td>
</tr>
<tr>
<td>cargo and freight agents</td>
<td>0.99</td>
<td>106.48</td>
</tr>
<tr>
<td>claims adjusters and investigators</td>
<td>0.98</td>
<td>102.05</td>
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<tr>
<td>tellers</td>
<td>0.98</td>
<td>93.25</td>
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<tr>
<td>telemarketers</td>
<td>0.99</td>
<td>91.54</td>
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<tr>
<td>tax preparers</td>
<td>0.99</td>
<td>78.70</td>
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<tr>
<td>data entry keyers</td>
<td>0.99</td>
<td>73.05</td>
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<tr>
<td>new accounts clerks</td>
<td>0.99</td>
<td>70.12</td>
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<tr>
<td>credit analysts</td>
<td>0.98</td>
<td>63.79</td>
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<tr>
<td>procurement clerks</td>
<td>0.98</td>
<td>53.44</td>
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<tr>
<td>accounting and auditing clerks</td>
<td>0.98</td>
<td>51.60</td>
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<tr>
<td>brokerage clerks</td>
<td>0.98</td>
<td>34.50</td>
</tr>
</tbody>
</table>
Summary and key take aways
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Job transitions and occupational mobility:

• A networks perspective on job transitions helps understand restrictions in occupational mobility in the labour market.

• Tasks in existing jobs appear to be more predictive of future career mobility than other variables.
Summary and key take aways

Division of labour:

- There are distinct segregation patterns in career mobility in the US labour force.

- A better understanding of these systemic divisions in the labour market, could help address polarization and gender-balance in the workplace.
Summary and key take aways

Automation impacts:

• Overall employment prospects for workers depend not only on the automatability of their current occupation, but also on the alternative jobs they are able to transition into.
Summary and key take aways

Automation impacts:

• Policies to help workers adapt to the changing labour market could be more efficiently targeted towards workers that are likely to face longer spells of unemployment, rather than only considering automation risks associated with their current job
Key references


Thank you!

@PennyMealy
Worker

Begin timestep employed in $i$

Begin timestep unemployed in $i$

Application submitted in $t-1$?

Yes

Application successful?

Yes

Application in $i$?

Yes

Apply to vacancy in $i$ or neighbours in $t+1$

End timestep employed in $i$

End timestep unemployed in $i$

No

No

Worker separated?

Yes

End timestep employed in $i$

End timestep unemployed in $i$

No

End timestep employed in $j$

Occupation $i$

Occupation $j$
Brown jobs?

Vona et al (2018)
Brown Job classification

- Brown job
- Non-brown job
But highly geographically concentrated...
But highly geographically concentrated… could **exacerbate** employment impacts

[Map of the United States showing concentration of dirty jobs by state, with varying degrees of concentration indicated by color]

*With Alex Pfeiffer, Cameron Hepburn & Jo Aldy*