Individual Consequences of Occupational Decline

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Georg Graetz (Uppsala), Sofia Hernnäs (Uppsala),
Guy Michaels (LSE)

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New machines enter the labor market
Research question

What are the consequences for individual workers when demand for their occupation declines?

- Study Swedish workers who in 1985 worked in occupations that subsequently (∼30 years) went into (unanticipated) decline

Motivation:

- Individual welfare
- Labor market inequality
- Human capital investments
- Taxation, redistribution, retirement
- Rise of populism
Methodology: Measuring occupational decline

Information on occupations from US Occupational Outlook Handbook (OOH, published by the BLS) to

- Identify declining occupations
- Check for technology drivers of declines
- Distinguish between anticipated and unanticipated declines

Match this occupational information to Swedish data

- Outcomes and covariates from rich longitudinal micro data
- Good reasons not to use actual Swedish occupational growth (see below)

Regress career outcomes (1986-2013) on dummy for working in a declining occupation in 1985
Preview of findings

1. Relative to similar workers, those exposed to occupational decline lose about 5 percent of mean cumulative earnings, around half of which is due to employment losses.
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6. Middle-aged workers (in 1985) in declining occupations retire slightly earlier (zero retirement difference for older workers).

7. Results are similar for technology-related declines.

8. Mean earnings loss similarly small using US (NLSY) data.
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Literature: Winners & losers from technological change

Lessons from history, economic theory

Forecasts of future job losses
- Range from pessimistic ∼50% (Frey & Osborne, 2017) to optimistic ∼10% (Arntz et al. 2016)

Evidence on individual losses from other adverse shocks
- Mass layoffs (Jacobson et al. 1993), trade (Autor et al. 2014)

But technology is trickier: how to measure individuals’ exposure to tech replacement?
- Following Autor et al. (2003), the literature has focused on tasks (routine vs non-routine)
- Cortes (2016) studies this using panel data on broad task categories
- We study occupations and can compare workers in similar occupations (e.g. typists vs secretaries)
Outline

Data

Empirical strategy

Results

A simple Roy model

Conclusion
Our baseline OOH in 1986-87 includes

- About 400 occupations (covering ∼80 percent of US employment) with current employment data and forecasts on employment for the decade ahead.
- About 200 of which (∼60 percent of US employment) also have info on technological changes.

How we use this information

- Compare OOH publication of 1986-87 to 2018-19 to identify declining occupations
  - Vanished, or employment declined by more than 25 percent
- For declining occupations, we search for technology drivers
- Use OOH forecasts from 1986-87
Using OOH data to study Swedish occupations

N:N match between \( \sim 1,400 \) Swedish and \( \sim 400 \) US occupations

Defining occupational decline

- A Swedish occupation is coded as ‘Declining’ if employment growth in corresponding US occupation(s) is \( < -25 \) percent
- A Swedish occupation is coded as ‘Declining (technology)’ if it is ‘Declining’ and there is a likely technology driver

Incidence of occupational decline

- 13 percent of 1985 Swedish employment was in \( (329) \) occupations that subsequently declined
Swedish population-level micro data

Large sample
- Full sample 3,061,051 individuals
- Main sample 877,324 individuals (aged 25-36 in 1985)

Labor earnings (pre-tax), industry, education, geography

Unemployment, retraining, other program participation (Public Employment Service)
- 1992-2013

Occupation
- every five years 1960-1990 for population, annually (large sample) 1996-2013
- classifications change, not always easy to map
- 1985-90 classification very detailed (∼1,400 occupations)
- 1996-2013 only 3-digit level (172 occupations in harmonized classification)
Why Swedish data?

We can control for

- Rich individual characteristics
- Occupation-level life-cycle profiles, 1-digit dummies, past employment and employment changes in Sweden
- Industry dummies (to absorb trade and goods demand shocks)

Large sample means we can investigate heterogeneity

- Who bears the largest costs of occupational decline?
- Losses by occupational earnings rank and age
Why use US-based dummy for decline?

Why use *US* changes instead of *Swedish* changes?
- More information in ~ 400 OOH vs 172 Swedish SSYK96
- SSYK96 defined ex-post and likely pools declining with non-declining
- Simultaneity (pick up supply changes, not demand)
- Occupational trends in Europe similar to US (Goos et al. 2014, Adermon & Gustavsson 2015)

Why report reduced form instead of using OOH decline as IV?
- Coarseness of SSYK96—worse for declining occupations; 2SLS exacerbates this problem
- Instrument becomes weak when adding relevant predictors

Why use dummy for decline instead of using full variation?
- Declines inherently interesting
- Sharp declines unlikely driven by supply
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What can we learn and how?

What are the consequences of occupational decline for individual workers’ careers?

- Career earnings, employment and mobility over 28 years of those aged 25-36 in 1985
- Early retirement for older workers
- Other outcomes of interest (health, family) — TBC

Econometric implementation

\[ y_{i,1986-2013} = \beta D_i + \begin{bmatrix} \text{individual controls} \\ \text{occupation controls} \\ \text{industry controls} \end{bmatrix} + \varepsilon_i \]

\[ D_i \equiv 1\{i \text{ works in an occupation in 1985 that subsequently declines}\} \]
What can we learn and how? Dealing with confounders

Non-random selection of workers into declining occupations
  ▶ Control for detailed demographics, education, prior income

Declining occupations may have different life-cycle earnings profiles, even in absence of decline
  ▶ Control for each worker’s predicted life-time income, based on earnings profile (1985) in initial 3-digit occupation

Sorting in 1985 due to anticipation or ongoing decline
  ▶ Control for OOH predictions, lagged Swedish growth, 1985 employment share → surprise declines

Further (unobserved) occupation-level confounders
  ▶ Include 1-digit occupation dummies

Trade, goods demand, other industry shocks
  ▶ Include 2-digit industry dummies

Risk of over-controlling? We report a range of estimates
Outline

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Conclusion
Occupational decline in US (OOH) predicts occupational decline in Sweden

<table>
<thead>
<tr>
<th></th>
<th>Change in log employment 1985-2013 (SWE)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
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<tr>
<td>Declining</td>
<td>-0.76</td>
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<tr>
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<td>(0.17)</td>
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<td>Employment share 1985 (SWE)</td>
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<td></td>
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<td>Employment growth 1960-85 (SWE)</td>
<td>0.34</td>
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<td></td>
<td>(0.08)</td>
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<td>Predicted growth index (US-OOH)</td>
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<td>(R^2)</td>
<td>0.12</td>
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</table>

Notes: The dependent variable is the change in the log of number of employees in each Swedish 3-digit occupation between 2013 and 1985. Regressions are weighted by 1985 Swedish employment shares. The number of observations is 172. Robust standard errors in parentheses.
Baseline (1985) characteristics for workers in subsequently declining occupations

<table>
<thead>
<tr>
<th>(1)</th>
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<tbody>
<tr>
<td>Female</td>
<td>Age</td>
<td>Compuls. school</td>
<td>High school</td>
<td>Collg.</td>
<td>Earnings</td>
<td>Manuf.</td>
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<td>A. Workers aged 16-64</td>
<td></td>
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<tr>
<td>Intercept</td>
<td>0.52</td>
<td>39.5</td>
<td>0.33</td>
<td>0.56</td>
<td>0.11</td>
<td>191.3</td>
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<td></td>
<td>(0.078)</td>
<td>(0.41)</td>
<td>(0.030)</td>
<td>(0.033)</td>
<td>(0.027)</td>
<td>(10.8)</td>
</tr>
<tr>
<td>Declining</td>
<td>-0.25</td>
<td>-0.89</td>
<td>0.13</td>
<td>-0.063</td>
<td>-0.070</td>
<td>-0.23</td>
</tr>
<tr>
<td></td>
<td>(0.088)</td>
<td>(0.63)</td>
<td>(0.035)</td>
<td>(0.034)</td>
<td>(0.028)</td>
<td>(11.0)</td>
</tr>
<tr>
<td>B. Workers aged 25-36</td>
<td></td>
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<tr>
<td>Intercept</td>
<td>0.51</td>
<td>30.8</td>
<td>0.23</td>
<td>0.64</td>
<td>0.13</td>
<td>182.8</td>
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<td></td>
<td>(0.078)</td>
<td>(0.078)</td>
<td>(0.022)</td>
<td>(0.033)</td>
<td>(0.032)</td>
<td>(9.28)</td>
</tr>
<tr>
<td>Declining</td>
<td>-0.26</td>
<td>-0.19</td>
<td>0.15</td>
<td>-0.065</td>
<td>-0.082</td>
<td>12.0</td>
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<td>(0.085)</td>
<td>(0.091)</td>
<td>(0.030)</td>
<td>(0.034)</td>
<td>(0.034)</td>
<td>(9.40)</td>
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Notes: The sample includes all individuals of the indicated ages who were employed in 1985. The number of observations is 3,061,051 in panel A and 877,324 in panel B. Robust standard errors, clustered by 1985 3-digit occupation, in parentheses.
Individual-level outcomes for Swedish workers: cumulative employment and earnings

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<tr>
<td><strong>A. Cumulative years employed 1986-2013 (mean: 23.4)</strong></td>
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<td>-0.49</td>
<td>-0.49</td>
<td>-0.30</td>
<td>-0.24</td>
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<tr>
<td></td>
<td>(0.26)</td>
<td>(0.20)</td>
<td>(0.20)</td>
<td>(0.20)</td>
<td>(0.18)</td>
<td>(0.14)</td>
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<tr>
<td><strong>B. Cumulative real earnings ('000 2014 SEK) 1986-2013 (mean: 6,926)</strong></td>
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<tr>
<td>Declining</td>
<td>-354</td>
<td>-347</td>
<td>-241</td>
<td>-117</td>
<td>-63</td>
<td>-126</td>
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<td></td>
<td>(419)</td>
<td>(120)</td>
<td>(81)</td>
<td>(76)</td>
<td>(71)</td>
<td>(58)</td>
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<tr>
<td><strong>C. Cumulative real earnings divided by predicted initial earnings (mean: 38.7)</strong></td>
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<tr>
<td>Declining</td>
<td>-4.29</td>
<td>-2.10</td>
<td>-2.21</td>
<td>-1.52</td>
<td>-0.98</td>
<td>-1.11</td>
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<tr>
<td></td>
<td>(0.91)</td>
<td>(0.53)</td>
<td>(0.54)</td>
<td>(0.54)</td>
<td>(0.41)</td>
<td>(0.36)</td>
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</tbody>
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Demographics & earnings ✓ ✓ ✓ ✓ ✓ ✓
Life-cycle profiles ✓ ✓ ✓ ✓ ✓ ✓
Predictors of growth ✓ ✓ ✓ ✓ ✓ ✓
Occupation dummies ✓ ✓ ✓ ✓ ✓ ✓
Industry dummies ✓ ✓ ✓ ✓ ✓ ✓

Notes: The sample includes all individuals who were born between 1949-1960 and who were employed in 1985. The number of observations is 877,324. Robust standard errors, clustered by 1985 3-digit occupation, in parentheses.
Individual-level outcomes for Swedish workers: probability of remaining in the initial occupation

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<tbody>
<tr>
<td>A. Probability of working in same 3-digit occupation in 2013 as in 1985 (mean: 0.29)</td>
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<tr>
<td>Declining</td>
<td>-0.14</td>
<td>-0.11</td>
<td>-0.11</td>
<td>-0.065</td>
<td>-0.086</td>
<td>-0.045</td>
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<tr>
<td></td>
<td>(0.043)</td>
<td>(0.041)</td>
<td>(0.042)</td>
<td>(0.032)</td>
<td>(0.035)</td>
<td>(0.020)</td>
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<td>B. Probability of working in same 2-digit occupation in 2013 as in 1985 (mean: 0.35)</td>
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<tr>
<td>Declining</td>
<td>-0.12</td>
<td>-0.088</td>
<td>-0.087</td>
<td>-0.051</td>
<td>-0.070</td>
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<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.035)</td>
<td>(0.030)</td>
<td>(0.030)</td>
<td>(0.019)</td>
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<tr>
<td>C. Probability of working in same 1-digit occupation in 2013 as in 1985 (mean: 0.40)</td>
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<tr>
<td>Declining</td>
<td>-0.098</td>
<td>-0.070</td>
<td>-0.069</td>
<td>-0.039</td>
<td>-0.060</td>
<td>-0.031</td>
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<tr>
<td></td>
<td>(0.030)</td>
<td>(0.031)</td>
<td>(0.032)</td>
<td>(0.029)</td>
<td>(0.027)</td>
<td>(0.018)</td>
</tr>
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Demographics & earnings                    ✓ ✓ ✓ ✓ ✓ ✓
Life-cycle profiles                         ✓ ✓ ✓ ✓ ✓ ✓
Predictors of growth                        ✓ ✓ ✓ ✓ ✓ ✓
Occupation dummies                          ✓ ✓ ✓ ✓ ✓ ✓
Industry dummies                            ✓ ✓ ✓ ✓ ✓ ✓

Notes: The sample includes all individuals who were born between 1949 and 1960, who were employed in 1985, and who were sampled in the Wage Structure Statistics or non-employed in 2013. Sampling weights are applied. The number of observations is 553,169. Robust standard errors, clustered by 1985 3-digit occupation, in parentheses.
Robustness to alternative functional forms

Using different cutoffs for defining occupational decline

▶ Broadly, more conservative cutoff give larger losses
▶ Comparison group: results unchanged when dropping fast-growing occupations

Using continuous changes as regressors

▶ Likely reflect supply as well as demand shifts
▶ Broadly similar results
Counterfactual earnings trajectories

How may workers in declining occupations have fared in the absence of occupational decline? Do workers in non-declining occupations, conditional on observable characteristics, give a plausible counterfactual?

- In short run, very small differences, if any
- Older workers seem largely unaffected (less exposure), see below
- No systematic differences in prior (1975 & 1980) earnings

Results
Heterogeneity by occupational earnings rank

<table>
<thead>
<tr>
<th></th>
<th>Employment (1)</th>
<th>Earnings (2)</th>
<th>Earnings, normalized (3)</th>
<th>Remain (4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
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</thead>
<tbody>
<tr>
<td><strong>A. Linear interaction</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Declining</td>
<td>-0.51</td>
<td>-0.23</td>
<td>-353.5</td>
<td>-131.0</td>
<td>-2.16</td>
<td>-1.19</td>
<td>-0.11</td>
<td>-0.045</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(0.15)</td>
<td>(110.7)</td>
<td>(55.8)</td>
<td>(0.55)</td>
<td>(0.37)</td>
<td>(0.041)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>Declining × rank</td>
<td>1.17</td>
<td>1.17</td>
<td>441.5</td>
<td>449.2</td>
<td>2.63</td>
<td>2.63</td>
<td>-0.011</td>
<td>-0.0010</td>
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<td></td>
<td>(0.34)</td>
<td>(0.30)</td>
<td>(142.3)</td>
<td>(146.8)</td>
<td>(0.58)</td>
<td>(0.57)</td>
<td>(0.023)</td>
<td>(0.017)</td>
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<tr>
<td><strong>B. Dummy interactions</strong></td>
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<td></td>
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</tr>
<tr>
<td>Declining</td>
<td>-0.32</td>
<td>-0.031</td>
<td>-323.2</td>
<td>-98.0</td>
<td>-1.94</td>
<td>-0.97</td>
<td>-0.083</td>
<td>-0.022</td>
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<tr>
<td></td>
<td>(0.24)</td>
<td>(0.18)</td>
<td>(123.8)</td>
<td>(66.7)</td>
<td>(0.54)</td>
<td>(0.41)</td>
<td>(0.045)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>Declining × bottom tercile</td>
<td>-1.12</td>
<td>-1.13</td>
<td>-341.8</td>
<td>-350.1</td>
<td>-2.10</td>
<td>-2.06</td>
<td>-0.046</td>
<td>-0.040</td>
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<td></td>
<td>(0.35)</td>
<td>(0.33)</td>
<td>(106.7)</td>
<td>(101.5)</td>
<td>(0.54)</td>
<td>(0.51)</td>
<td>(0.014)</td>
<td>(0.013)</td>
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<tr>
<td>Declining × top tercile</td>
<td>0.54</td>
<td>0.55</td>
<td>232.3</td>
<td>235.1</td>
<td>1.37</td>
<td>1.40</td>
<td>-0.047</td>
<td>-0.030</td>
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<td>(0.20)</td>
<td>(0.16)</td>
<td>(135.8)</td>
<td>(132.1)</td>
<td>(0.43)</td>
<td>(0.48)</td>
<td>(0.027)</td>
<td>(0.018)</td>
</tr>
</tbody>
</table>

**Individual controls**
- ✓

**Occupation & industry controls**
- ✓

**Mean of dep. var.**
- 23.4
- 6,926
- 38.7
- 0.29

**Mean of dep. var., bottom**
- 22.3
- 6,001
- 35.6
- 0.27

**Observations**
- 877,324
- 553,786

**Notes:** Rank ranges from -1 to 1. Ranks are calculated in the full sample within each 3-digit occupation in 1985.
## Unemployment & retraining

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<thead>
<tr>
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<th>(1)</th>
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<tbody>
<tr>
<td><strong>A. Unemployment, cumulative days (mean 262, mean for bottom tercile 317)</strong></td>
<td></td>
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<tr>
<td>Declining</td>
<td>52.4</td>
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<td>20.8</td>
<td>20.5</td>
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<td>(24.8)</td>
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<td>(14.0)</td>
<td>(18.2)</td>
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<tr>
<td>Declining × rank</td>
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<td>(21.5)</td>
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<td>Declining × bottom tercile</td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(17.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **B. Retraining, cumulative days (mean 29, mean for bottom tercile 35)** |       |       |       |       |
| Declining                    | 11.4  | 4.73  | 5.04  | 5.81  |
|                              | (2.68)| (1.46)| (1.48)| (2.26)|
| Declining × rank             |       | -8.63 |       |       |
|                              |       | (1.98)|       |       |
| Declining × bottom tercile   |       | 4.38  |       |       |
|                              |       | (2.28)|       |       |
| Declining × top tercile      |       | -6.96 |       |       |
|                              |       | (2.12)|       |       |

| Individual controls          | ✓     | ✓     | ✓     | ✓     |
| Occupation & industry controls| ✓     | ✓     | ✓     | ✓     |

**Notes:** Rank ranges from -1 to 1.
Retirement

Workers aged 37-48 in 1985
- Lose 0.32 (SE 0.11) years of employment
- 0.15 (SE 0.07) years younger when retire
- Same pattern of heterogeneity

Workers aged 49-60 in 1985
- No significant effects on employment, earnings or retirement
- Very little exposure to decline
Further results

Spillovers on similar occupations? And comparing similar occupations problematic if treatment effects heterogenous

- Worker flows from declining to similar non-declining occupations could constitute supply shocks
- Effects larger when the similar occupations also decline

Results from ‘doughnut’ specifications similar, though suggest slightly larger losses

Declines related to technology

- Very similar to baseline results
US Data: National Longitudinal Survey of Youth 1979


Point estimates close to zero

- Imprecise on earnings (but rule out losses $\geq 7-8$ percent)
- Narrower confidence intervals on employment

NLSY79 vs Swedish micro data

- Smaller sample
- Younger sample in base year (perhaps less attached)
- Employment and earnings are self-reported
- Noisier occupation measure
- Sample non-response and attrition
Outline

Data

Empirical strategy

Results

A simple Roy model

Conclusion
Looking for mechanisms in a simple Roy model

- Competitive economy with a continuum of individuals \((i)\), two time periods, two occupations \(k \in \{A, B\}\)
- Earnings are consumed immediately (no savings)
- Workers’ per-period log earnings are

\[ y_{ikt} = \pi_{kt} + \alpha_{ik} - c_{ikt} \]

and they choose occupation path to maximize

\[ \mathbb{E}(y_{ik1} + \beta y_{ik2}) \]

- Normalize first-period occupation prices to \(\pi_{B1} - \pi_{A1} = 0\)
- Negative shock to \(A\) so that \(\pi_{B2} - \pi_{A2} = d\)
- For simplicity, skill distribution is assumed to be jointly uniform (not necessary for key results)
Baseline: no switching cost

- Switch from $A$ to $B$ if
  \[ \alpha_{iB} > \alpha_{iA} - d \]

- Probability of staying ↑ in $\alpha_{iA}$
- Earnings loss ↑ in $\alpha_{iA}$
- Intuition: Low-skilled in $A$ are also low-skilled in $B$, so they don’t lose much from moving.
Heterogeneous switching costs

- Cost of moving $c_{iBt} = C - \alpha_{iB}$
- Switch from $A$ to $B$ if
  \[
  \alpha_{iB} - (C - \alpha_{iB}) > \alpha_{iA} - d
  \]
- Probability of staying $\downarrow$ in $\alpha_{iA}$
- Earnings loss $\downarrow$ in $\alpha_{iA}$
- Intuition: Low-skilled in $A$ are also low-skilled in $B$, so it’s costly to move.
Heterogeneous switching costs and involuntary switching

- Displacement of A workers
- Cost of reemployment
  \[ c_{ikt} = C - \alpha_{ik} \]
- Displaced switch if
  \[ \alpha_{iB} - (C - \alpha_{iB}) > \alpha_{iA} - d - (C - \alpha_{iA}) \]
- Probability of staying has inverted U-shape in \( \alpha_{iA} \)
- Earnings losses ↓ in \( \alpha_{iA} \)
- Switchers may do worse than stayers on average
Outline

Data

Empirical strategy

Results

A simple Roy model

Conclusion
Conclusion

We aim to provide evidence of the long-run, individual consequences of occupational decline.

- Study 28-year careers of Swedish workers who in 1985 worked in an occupation that subsequently declined
- Detailed occupations allow us to measure exposure to decline
- Modest earnings and employment losses on average
- Heterogeneity — low-ranked suffered higher losses
- Those in declining occupations more likely to leave
- US data suggest similarly small mean losses
- Roy model with heterogeneity in switching costs and displacement can account for empirical findings
Policy implications

1. Mean loss from occupational decline lower than mass layoffs
   - Occupational decline is gradual (retirements)
   - Plenty of occupational switching in most occupations
   - Less risk of negative local spillovers

2. Governments should nevertheless be alert because
   - Losses for low earners can be high
   - Machine learning may speed up replacement process
   - In future, high-paid professionals may lose more
Related Occupations
Workers in a number of other jobs also must be good at working with figures. Among such workers are bank tellers, collection workers, insurance clerks, and statistical clerks.

Sources of Additional Information
Ask for information at your school guidance office or a state employment service office.

Computer and Peripheral Equipment Operators
(D.O.T. 208.65-030; 213.62, 382.3, 382.58, and 382.8)

Nature of the Work
Like their counterparts in the 1940’s, computers have become steadily more important in our society. At first used only for military and scientific research, today computers are essential to the operation of stores, banks, colleges and universities, government agencies, hospitals, factories, and many other organizations. Like all machines, the usefulness of computers is dependent upon the skill of the people who run them. The duties of computer and peripheral equipment operators vary with the size of the installation, the type of equipment used, and the policies of the employer. In organizations with small computer systems, for example, computer operators may run both the computer and all the peripheral equipment such as printers, disk drives, and tape readers. In large computer installations, computer operators specialize in one phase of computing while peripheral equipment operators run the related devices. Generally, the duties of computer and peripheral equipment operators involve the following tasks.

Preparing output for distribution is the responsibility of a peripheral equipment operator.

Preparing output for distribution is the responsibility of a peripheral equipment operator.

Preparing output for distribution is the responsibility of a peripheral equipment operator.

Preparing output for distribution is the responsibility of a peripheral equipment operator.

Preparing output for distribution is the responsibility of a peripheral equipment operator.
Bank tellers

*The number of bank tellers is expected to increase more slowly than the average for all occupations through the mid-1990’s because of the increasing use of automatic teller machines and other electronic equipment.*

Bookkeepers and accounting clerks

*The volume of business transactions is expected to grow rapidly, with a corresponding increase in the need for financial and accounting records. However, the need for bookkeepers, who maintain these records, will not increase nearly as fast because of the increasing use of computers to record, store, and manipulate data.*

Precision assemblers

*The effect of automation on precision assembler employment will depend on how rapidly and extensively new manufacturing technologies are adopted. Certainly, not all precision assemblers can be replaced efficiently by automated processes. Robots are expensive and a large volume of work is required to justify their purchase.*
Using OOH data to study Swedish occupations: Forecasts

US Bureau of Labor Statistics (BLS) base forecasts on
- The size and demographic composition of the labor force
- Aggregate economic growth
- Commodity final demand
- Input-output
- Industry output and employment
- Occupational employment and vacancies

For each Swedish occupation, we assign the forecast of the corresponding US occupation
- Declining [1], little or no change [2], increasing slower than average [3], increasing about as fast as average [4], increasing faster than average [5]
## Mapping between NYK and OOH

<table>
<thead>
<tr>
<th>OOH 86</th>
<th>NYK 85</th>
</tr>
</thead>
<tbody>
<tr>
<td>53 Dentists</td>
<td>121.10 Dentist</td>
</tr>
<tr>
<td>314 Custom tailors and sewers</td>
<td>71110 Tailor (men’s clothing)</td>
</tr>
<tr>
<td></td>
<td>711.20 Tailor (women’s clothing)</td>
</tr>
<tr>
<td></td>
<td>711.90 Other within 711 (tailoring)</td>
</tr>
<tr>
<td>313 Crushing and mixing machine operators and tenders</td>
<td>809.90 Other within 80 (graphical industry)</td>
</tr>
<tr>
<td></td>
<td>819.10 Batch preparer (ceramics)</td>
</tr>
<tr>
<td></td>
<td>819.20 Batch preparer (glass)</td>
</tr>
<tr>
<td></td>
<td>819.30 Glazing preparer</td>
</tr>
<tr>
<td></td>
<td>821.10 Mill operator</td>
</tr>
<tr>
<td></td>
<td>821.20 Machine operator (food stuff)</td>
</tr>
<tr>
<td></td>
<td>829.30 Macaroni machine operator</td>
</tr>
<tr>
<td></td>
<td>829.40 Margarine preparer</td>
</tr>
<tr>
<td></td>
<td>829.50 Fruit presser</td>
</tr>
<tr>
<td></td>
<td>833.10 Crusher operator</td>
</tr>
<tr>
<td></td>
<td>833.20 Grinder operator</td>
</tr>
<tr>
<td></td>
<td>833.60 Grating machine operator (for handling color mixtures)</td>
</tr>
<tr>
<td></td>
<td>839.10 Mixing machinery operator</td>
</tr>
<tr>
<td></td>
<td>839.20 Soap machinery operator</td>
</tr>
<tr>
<td></td>
<td>839.30 Color refraction machinery operators</td>
</tr>
<tr>
<td></td>
<td>839.40 Granulator</td>
</tr>
<tr>
<td></td>
<td>851.10 Mixer (building materials)</td>
</tr>
</tbody>
</table>
The growth rate of a Swedish occupation $s$ is computed as

$$g_s = \alpha_s \times \frac{g}{1 \times K} \times \frac{1}{K \times 1}$$

$$= \alpha_s \times \mathbb{1}\{\text{tech}\} \times \frac{g}{K \times K} \times \frac{1}{K \times 1} + \alpha_s \times (1 - \mathbb{1}\{\text{tech}\}) \times \frac{g}{K \times K} \times \frac{1}{K \times 1}$$

where $\alpha_s$ are the shares of each US occupation in Swedish occupation $s$, and $g$ are the growth rates of all US occupations.

- ‘Declining’ if $g_s < -0.25$
- ‘Declining (tech)’ if ‘Declining’ and $\alpha_s \times \mathbb{1}\{\text{tech}\} \times g < -0.25$
Differences in cumulative earnings over time

Cumulative earnings ('000 2014 SEK)

Individual controls

Individual, occupation, industry controls
Differences in cumulative earnings (div. by mean) over time

Cumulative earnings, divided by mean

- Individual controls
- Individual, occupation, industry controls


Cumulative earnings, divided by mean
Prior earnings as outcome variable

Young (born 1949-1955)

Middle (born 1937-1948)

Old (born 1925-1936)

Declining

Pre, individual controls

Pre, all controls

Post, individual controls

Post, all controls
Cumulative earnings (residualized) and employment growth

Individual controls

- Declining
- Non-declining

Individual, occupation, & industry controls

- Declining
- Non-declining
Fraction remaining (residualized) and employment growth

Individual controls

- Declining
- Non-declining

Individual, occupation, & industry controls

- Declining
- Non-declining
## Alternative cutoffs for ‘Declining’

<table>
<thead>
<tr>
<th>Percent change ∈ [−100, −50)</th>
<th>Employment (1)</th>
<th>Earnings (3)</th>
<th>Earnings, normalized (5)</th>
<th>Remain (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.34</td>
<td>-248.1</td>
<td>-2.44</td>
<td>-0.18</td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(115.6)</td>
<td>(0.62)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>Percent change ∈ [−100, −25)</td>
<td>-0.49</td>
<td>-346.6</td>
<td>-2.10</td>
<td>-0.11</td>
</tr>
<tr>
<td>(baseline)</td>
<td>(0.20)</td>
<td>(120.3)</td>
<td>(0.53)</td>
<td>(0.041)</td>
</tr>
<tr>
<td></td>
<td>-0.043</td>
<td>-35.0</td>
<td>-0.70</td>
<td>-0.15</td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(158.8)</td>
<td>(0.70)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>Percent change ∈ [−100, 0)</td>
<td>0.14</td>
<td>-46.5</td>
<td>-0.55</td>
<td>-0.087</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(150.7)</td>
<td>(0.57)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>Percent change ∈ [−100, 31)</td>
<td>-0.72</td>
<td>-460.5</td>
<td>-2.40</td>
<td>-0.077</td>
</tr>
<tr>
<td>(below median)</td>
<td>(0.22)</td>
<td>(123.3)</td>
<td>(0.51)</td>
<td>(0.038)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Baseline; control: percent change ∈ (−25, 31)</th>
<th>Employment (1)</th>
<th>Earnings (3)</th>
<th>Earnings, normalized (5)</th>
<th>Remain (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.27</td>
<td>-126.6</td>
<td>-1.17</td>
<td>-0.053</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(61.9)</td>
<td>(0.40)</td>
<td>(0.018)</td>
</tr>
</tbody>
</table>

| Individual controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Occupation & industry controls            | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations                                | 877,324        | 553,786     |

**Notes:** Each row represents a regression on a ‘Declining’ dummy (varying definitions) and controls. The underlying variable for ‘Declining’ is the percentage change in employment for the US occupation(s) corresponding to the Swedish 5-digit occupation that the individual worked in during 1985.
## Continuous employment changes

<table>
<thead>
<tr>
<th></th>
<th>Employment (1)</th>
<th>Earnings (3)</th>
<th>Earnings, normalized (5)</th>
<th>Remain (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent employment change / 100 (US)</td>
<td>-0.019 (0.037)</td>
<td>103.7 (30.2)</td>
<td>0.47 (0.11)</td>
<td>0.0058 (0.0068)</td>
</tr>
<tr>
<td></td>
<td>-0.026 (0.036)</td>
<td>64.7 (14.9)</td>
<td>0.25 (0.13)</td>
<td>-0.0020 (0.0029)</td>
</tr>
<tr>
<td>Percent employment change / 100 (US), winsorized</td>
<td>0.010 (0.11)</td>
<td>83.8 (112.0)</td>
<td>0.86 (0.40)</td>
<td>0.051 (0.025)</td>
</tr>
<tr>
<td></td>
<td>0.000027 (0.080)</td>
<td>91.1 (47.5)</td>
<td>0.46 (0.25)</td>
<td>0.0035 (0.014)</td>
</tr>
<tr>
<td>Log employment change (SWE)</td>
<td>-0.034 (0.15)</td>
<td>306.4 (135.1)</td>
<td>0.85 (0.50)</td>
<td>0.11 (0.031)</td>
</tr>
<tr>
<td></td>
<td>0.049 (0.11)</td>
<td>73.7 (65.9)</td>
<td>0.087 (0.50)</td>
<td>0.066 (0.017)</td>
</tr>
</tbody>
</table>

| Individual controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Occupation & industry controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Observations        | 877,324 | 553,786 |

**Notes:** ‘Percent employment change (US)’ refers to the percentage change in employment 1984-2016 for the US occupation(s) corresponding to the Swedish 5-digit occupation that the individual worked in during 1985. ‘Log employment change (SWE)’ refers to the change in log number employed 1985-2013 in the Swedish 3-digit occupation that the individual works in during 1985.
US Data: National Longitudinal Survey of Youth 1979 (NLSY)

- Individuals born between 1957 and 1964
  - Cross-sectional & supplemental black & Hispanic samples
- Surveyed annually 1979 - 1994 and biennially through 2014 (weighted accordingly)

Methodology

- Set 1987 as base year to use the same OOH as Sweden but let the youngest NLSY reach age 22
- Control variables as in Sweden, except region (not county) dummies and no employment share or prior growth controls
- Use 1980 census to construct occupation life-cycle profiles
- Impute income for years respondents were not interviewed
## NLSY Main Results

<table>
<thead>
<tr>
<th></th>
<th>Average Earnings</th>
<th>Cumulative Earnings</th>
<th>Remain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td><strong>A. Individual Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Declining</td>
<td>-150.7</td>
<td>122.7</td>
<td>-91.9</td>
</tr>
<tr>
<td></td>
<td>(1589.2)</td>
<td>(1901.1)</td>
<td>(2028.5)</td>
</tr>
<tr>
<td><strong>B. Individual Controls and Occupation Controls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Declining</td>
<td>-23.8</td>
<td>384.3</td>
<td>227.0</td>
</tr>
<tr>
<td></td>
<td>(1536.3)</td>
<td>(1822.5)</td>
<td>(1969.2)</td>
</tr>
<tr>
<td>Mean of dep. var.</td>
<td>44,083</td>
<td>46,057</td>
<td>46,891</td>
</tr>
<tr>
<td>Observations</td>
<td>6,679</td>
<td>5,817</td>
<td>5,750</td>
</tr>
</tbody>
</table>

|                          |        |      |      |      |      |      |      |      |
| Odd years only           | ✓      |      |      |      |      |      |      |      |
| Income interpolation     | ✓      | ✓    | ✓    | ✓    | ✓    |      |      |      |
| Normalized earnings      |         |      |      | ✓    |      |      |      |      |
| Occupation group         | ✓      |      |      |      |      |      |      |      |
| Major occupation group   |         |      |      |      |      | ✓    |      |      |

**Notes:** The sample for the earnings regressions includes all individuals with an occupation in 1987 and at least 8 years of reported earnings. The sample for the occupational stability regressions includes all individuals with an occupation in 1987 and who were interviewed or deceased in 2014. Sampling weights are applied. Robust standard errors, clustered by 1987 occupation, in parentheses.