Exposure(s) to Trade and Earnings Dynamics: Evidence from the Collapse of Finnish-Soviet Trade

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March 2023
How do local labor markets shape the response to trade shocks?

- **Hypothesis #1:** There are more exposed workers in more exposed markets, but those exposed to negative trade shocks fare equally poorly across markets.

- **Hypothesis #2:** There is something systematically different about experience of exposed workers in the most negatively affected markets.

Better understanding of the role played by local labor market conditions may also help shed light on structural relationship between trade and inequality.
How do local labor markets shape the response to trade shocks?

- **Hypothesis #1:** There are more exposed workers in more exposed markets, but those exposed to negative trade shocks fare equally poorly across markets.

- **Hypothesis #2:** There is something systematically different about experience of exposed workers in the most negatively affected markets.

Hypothesis #1 versus hypothesis #2 has obvious policy implications:

- #1 → National social programs compensating workers regardless of location well suited (unemployment benefits, trade adjustment assistance).
- #2 → Scope for the same programs to inherit characteristics of place-based policies (as advocated by Austin, Glaeser, and Summers 2018).

Better understanding of the role played by local labor market conditions may also help shed light on structural relationship between trade and inequality.
To Make Progress on this Question

• **Focus on a Massive Trade Shock**
  ▶ Collapse of the Finnish-Soviet bilateral trade agreement in 1990
  ▶ Newly-digitized Finnish firm exports to USSR + matched employer-employee data
  ▶ Measure both **worker exposure** and **market exposure** to the USSR shock
    ▶ Worker exposure \( (s) \) = USSR export share of output of a worker’s plant in 1989
    ▶ Market exposure \( (S) \) = Employment-weighted average of USSR export shares of output of a market’s plants in 1989

• **Study earnings trajectories of Finnish workers from 1985 to 2004**
  ▶ How path of earnings varies with worker exposure to the USSR shock \( (s) \)
  ▶ As well as how impact of worker exposure varies with market exposure \( (s \times S) \)
Road Map

1. **Historical Background and Data**
   - Collapse of the Finnish-Soviet trade agreement
   - Measures of worker and market exposure and other data sources

2. **Reduced-form results on trade exposures and earnings dynamics**
   - More exposed workers systematically experience lower earnings after the shock
   - Negative effect of worker exposure persistently larger in more exposed markets, a form of local scarring

3. **Exploration of wage rigidity as driver of earnings dynamic**
   - Theory: Simple model of labor-market dynamics with wage rigidity
     - Rationalizes previous reduced-form results on earnings
     - Delivers additional predictions about employment and wage dynamics
   - Empirics: Supporting evidence for additional predictions
Related Literature

- Shift-share literature analyzing impact of negative labor demand shocks on market-level outcomes [Blanchard + Katz (92), Topalova (10), ADH (13), Kovak (13), Dix-Carniero + Kovak (17)]...
  - We directly observe market shock, focus on worker outcomes ADHS (2014), Yagan (2019), ...
  - We observe more granular worker exposure, allowing us to study interaction of worker and market exposure

- USSR shock has featured prominently in analyses of Finnish Great Depression [Honkapohja and Koskela (99), Jonung et al. (09), Gorodnichenko et al. (12), Gulan et al. (21), Einiö (18)]...

- Empirical analysis related to displacement literature [Jacobson et al. (1993), Couch + Placzek (2010)]...
  - Through the lens of our model, our regressions are the RFs of 2SLS regressions

- Workhorse dynamic model of trade and labor markets: slow transition driven by idiosyncratic preference shocks [Artuç et al. (10), Dix-Carneiro (14), Caliendo et al. (19), and Traiberman (19)]
  - We emphasize wage rigidities [Friedman (53), Akerlof et al. (96), Rodriguez-Clare et al. (20)]...
  - We get opposite predictions for employment and wage dynamics in short-run and long-run, for which we find support in the data
Historical Background and Data
The Finnish-USSR Trade Arrangement and its Demise

- Series of five-year, bilateral trade agreements starting in 1951
  - Trade was required to be annually balanced
  - Finland imported energy (world price) exported manufactures (negotiated high price)
- USSR unilaterally cancelled the agreement on Dec 6th, 1990

- This persistent drop is what we will refer to as the “USSR shock”
Constructing Exposure(s) to the USSR Shock

• We start with data on exports to the USSR at the firm-and-product level
  ▶ Firms required to notify Office of Licenses of all transactions w/ Soviet Union
  ▶ Published these transactions in biweekly reports
  ▶ We have digitalized all reports for the year 1989
  ▶ \( x_{fp,1989} = \text{value of exports to USSR of product } p \text{ by firm } f \text{ in 1989} \)

• We combine previous data with data on gross output at the plant-and-product level
  ▶ We link exports data w/ Longitudinal Data on Plants in Finnish Manufacturing (LDPM)
  ▶ Info on inputs, outputs, the municipalities in which their plants are located, …
  ▶ \( q_{jp,1989} = \text{value of gross output of plant } j \text{ product } p \text{ for all } j \text{ in LDPM} \)

• This allows us to construct plant-level USSR export intensity:

\[
S_j \equiv \frac{x_{j,1989}}{q_{j,1989}}
\]

\( x_{j,1989} \equiv \sum_p x_{fp,1989} \times \left( \frac{q_{jp,1989}}{q_{fp,1989}} \right) \) is plant \( j \)'s (inferred) USSR exports

\( q_{j,1989} \equiv \sum_p q_{jp,1989} \) is plant \( j \)'s total gross output
Municipality $m$ exposure to USSR Shock

$$S_m \equiv \sum_{j \in J_m} \omega_j s_j$$

with weights equal to the employment share of plant $j$ in market $m$ in 1989
Worker Exposure to the USSR Shock

- For each worker $i$, observe personal ID number and a firm and plant identifier which we use to match workers to their employers in 1989: $s_i \equiv s_j$
- Exposure to USSR Shock was extremely skewed

Distributions of Worker Exposure (conditional on $s_i > 0$) in the Top and Bottom Quartiles of Market Exposure
Other Data Sources

- Baseline outcome variable is **annual earnings**
  - Finnish Tax Authority (wage and salary)
  - All earnings deflated to 2010 euros (markka-euro exchange rate and Finland’s Cost-of-living index)
  - Winsorize annual income at the top 1% within each year (following ADHS 2014)

- Later consider **days of employment** and **hourly wage**
  - Days of employment during a year as recorded in the Pension Register
    - Limitation: No information on hours or intermittent work during spell
  - Hourly wage from Confederation of Finnish Industry (TT) survey data
    - Limitation: Only available for smaller sample (large firms in manufacturing, construction)
Reduced-form Results on Trade Exposures and Earnings Dynamics
Empirical Design(s)

**Goal**: Estimate the effect of market exposures, $s_i$ and $S_m$, on the path of Finnish workers’ earnings $y_{i,t}$ over the 1985-2004 period

1. Design (I): Study incidence of worker exposure, $s_i$, on annual earnings, $y_{it}$
   - **Double-Difference**: Compare changes in earnings trajectories of more and less exposed workers who are similar in terms of other observable characteristics
     \[
     \Delta y_{it} = \beta_t s_i + \text{Controls}_i' \zeta_t + \varepsilon_{it}
     \]
     where $\Delta y_{it} \equiv y_{it} - y_{i}^{pre}$ and Controls$_i$ is a long vector of initial characteristics, including municipality fixed-effects (workers location in 1989)
Empirical Design(s)

**Goal**: Estimate the effect of market exposures, $s_i$ and $S_m$, on the path of Finnish workers’ earnings $y_{i,t}$ over the 1985-2004 period

---

Design (I): Study incidence of worker exposure, $s_i$, on annual earnings, $y_{i,t}$

▶ **Double-Difference**: Compare changes in earnings trajectories of more and less exposed workers who are similar in terms of other observable characteristics

$$
\Delta y_{it} = \beta_t s_i + \text{Controls}' \zeta_t + \varepsilon_{it}
$$

Design (II): Study how previous incidence varies with market exposure, $S_m$

▶ **Triple-Difference**: Compare differences between changes in earnings trajectories of more versus less exposed workers in more and less exposed markets

$$
\Delta y_{it} = \beta_t s_i + \gamma_t (s_i \times S_m) + \text{Controls}' \zeta_t + \varepsilon_{it}
$$
Worker Controls and Sample

• Controls:
  ▶ Municipality fixed-effects (where individual $i$ located in 1989)
  ▶ Characteristics of employer (plant where individual $i$ worked in 1989)
    ▶ avg pre-shock earnings, plant output*, capital/labor ratio*
      (*missing category for non-manuf)
    ▶ manufacturing fixed-effects
  ▶ Characteristics of the worker
    ▶ birth year, gender, language, education level + field, pre-shock earnings

• Sample:
  ▶ Private sector
  ▶ High labor force attachment (following ADHS 2014)
  ▶ Born 1945-1967
Table 1: Worker controls, 1989

<table>
<thead>
<tr>
<th>“Attached workers”</th>
<th>Baseline sample (1)</th>
<th>Manufacturing (2)</th>
<th>Hourly wage (3)</th>
<th>All private sector (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A: Employer characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average annual earnings</td>
<td>26,517</td>
<td>26,400</td>
<td>26,774</td>
<td>25,583</td>
</tr>
<tr>
<td>(7,430)</td>
<td>(6,018)</td>
<td>(5,211)</td>
<td>(7,553)</td>
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<tr>
<td>Output (LDPM)</td>
<td>67.4</td>
<td>69.2</td>
<td>86.6</td>
<td>64.3</td>
</tr>
<tr>
<td>(155.6)</td>
<td>(158.7)</td>
<td>(173.3)</td>
<td>(152.4)</td>
<td></td>
</tr>
<tr>
<td>Capital-labor ratio (LDPM)</td>
<td>102.8</td>
<td>86.3</td>
<td>118.4</td>
<td>97.7</td>
</tr>
<tr>
<td>(220.1)</td>
<td>(137.9)</td>
<td>(203.6)</td>
<td>(212.3)</td>
<td></td>
</tr>
<tr>
<td><strong>B: Worker socio-demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year of birth</td>
<td>1953.8</td>
<td>1953.6</td>
<td>1953.8</td>
<td>1955.1</td>
</tr>
<tr>
<td>(5.9)</td>
<td>(5.8)</td>
<td>(5.9)</td>
<td>(6.5)</td>
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</tr>
<tr>
<td>Female</td>
<td>0.35</td>
<td>0.30</td>
<td>0.21</td>
<td>0.39</td>
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<tr>
<td>First language Finnish</td>
<td>0.95</td>
<td>0.95</td>
<td>0.97</td>
<td>0.94</td>
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<tr>
<td>First language Swedish</td>
<td>0.05</td>
<td>0.04</td>
<td>0.03</td>
<td>0.05</td>
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<tr>
<td>Other first language</td>
<td>0.003</td>
<td>0.002</td>
<td>0.001</td>
<td>0.003</td>
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<tr>
<td>Less than secondary/unknown degree</td>
<td>0.32</td>
<td>0.34</td>
<td>0.42</td>
<td>0.30</td>
</tr>
<tr>
<td>Lower secondary degree</td>
<td>0.37</td>
<td>0.43</td>
<td>0.55</td>
<td>0.38</td>
</tr>
<tr>
<td>Upper secondary degree</td>
<td>0.20</td>
<td>0.15</td>
<td>0.03</td>
<td>0.22</td>
</tr>
<tr>
<td>Lower tertiary degree</td>
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<td>0.04</td>
<td>0.00</td>
<td>0.05</td>
</tr>
<tr>
<td>Higher tertiary degree</td>
<td>0.06</td>
<td>0.05</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>General, arts or teaching degree</td>
<td>0.06</td>
<td>0.03</td>
<td>0.01</td>
<td>0.07</td>
</tr>
<tr>
<td>Business degree</td>
<td>0.16</td>
<td>0.09</td>
<td>0.02</td>
<td>0.16</td>
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<tr>
<td>Technical degree</td>
<td>0.36</td>
<td>0.48</td>
<td>0.49</td>
<td>0.34</td>
</tr>
<tr>
<td>Degree in other fields</td>
<td>0.10</td>
<td>0.05</td>
<td>0.06</td>
<td>0.13</td>
</tr>
<tr>
<td>Degree unknown / missing</td>
<td>0.32</td>
<td>0.34</td>
<td>0.42</td>
<td>0.30</td>
</tr>
<tr>
<td>Annual earnings</td>
<td>28,354</td>
<td>27,765</td>
<td>26,229</td>
<td>25,337</td>
</tr>
<tr>
<td>(13,101)</td>
<td>(11,508)</td>
<td>(7,231)</td>
<td>(13,483)</td>
<td></td>
</tr>
<tr>
<td><strong>C: Sector of employment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.36</td>
<td>1.00</td>
<td>0.70</td>
<td>0.33</td>
</tr>
<tr>
<td>Observations</td>
<td>627,070</td>
<td>222,611</td>
<td>140,860</td>
<td>830,639</td>
</tr>
</tbody>
</table>

Notes:
This table shows means and standard deviations (in parentheses) of background characteristics measured in 1989 for our main sample of “attached workers” (column 1), the subset of those only working in manufacturing in 1989 (column 2), those included in our hourly-wage sample (column 3), and all private sector workers (column 4).
Exposure(s) to Trade and Earnings Dynamics
Double-Difference Specification (Baseline)

\[ \Delta y_{it} = \beta_t s_i + \text{Controls}' \zeta_t + \varepsilon_{it} \]

Direct effect of worker exposure \((s_i)\) on earnings

- In 1992, worker at the 90th percentile of exposure experiences 808 euros ↓ compared to worker at 10th percentile (conditional on \(s_i > 0\)), ≈ 3% of annual earnings
\[ \Delta y_{it} = \beta_t s_i + \text{Controls}' \zeta_t + \epsilon_{it} \]

Direct effect of worker exposure \((s_i)\) on earnings

• Another way to interpret the magnitude of \(\beta_t\) is as the RF of a 2SLS regression:
  ▶ 1st stage: regress a dummy for being fired on exposure to the USSR shock
  ▶ 2nd stage: regress earnings on a dummy for being fired similar to regression in mass-layoff literature

• Assume that, consistent with our model, probability that worker \(i\) is fired is \(s_i\)
  ▶ \(\Rightarrow\) 1st-stage coefficient is one \(\Rightarrow \hat{\beta}_{1992} = -3,858\) euros of earnings losses for a fired worker, or approximately 15 percent of average annual income
Exposure(s) to Trade and Earnings Dynamics
Triple-Difference Specification (Baseline)

\[ \Delta y_{it} = \beta_t s_i + \gamma_t (s_i \times S_m) + \text{Controls}'_i \zeta_t + \varepsilon_{it} \]

Interaction effect of worker and market exposure \((s_i \times S_m)\) on earnings

- Within more exposed local labor markets, worker exposure leads to both larger and more persistent earnings declines, a form of local scarring

- Moving from 10th to 90th percentile of \(s_i > 0\) distribution in 1992:
  - in 10th percentile exposure muni: 652 ↓ euros
  - in 90th percentile exposure muni: decline is \(\approx 10\%\) larger

- Spatial counterpart of results in labor literature about heterogeneous impact of mass lay-offs over the business cycle e.g., Davis and von Wachter (11), Farber (17), and Schmieder et al. (19)
Interaction effect of worker and market exposure \((s_i \times S_m)\), with fewer controls

Controlling for:
- Municipality FE
- + employer characteristics
- + worker characteristics
- + manufacturing (baseline)

Interaction effect of worker and market exposure \((s_i \times S_m)\), with extra controls

Controlling for:
- Baseline
- Baseline + 2-digit industry
- Baseline + \(s_i^2\)
- Baseline + \(s_i^*\) (Municipality characteristics in 1989)
Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Other Robustness Checks)

- Relative vs. Absolute Earnings
- Alternative Worker Samples
- Alternative Measures of Market Exposure
Wage Rigidity as Driver of Earnings Dynamics
(Part I: Theory)
A Simple Model with Wage Rigidity

Time is continuous and indexed by $t$

1. Labor market w/ fixed set of workers, $i \in \mathcal{I}$, and plants, $j \in \mathcal{J}$

2. Plant $j$ employment equals labor demand at $t$: $E_{jt} = \phi_{jt} W_t^{-\sigma}$

3. Workers are either employed or unemployed: $E_t + U_t = N$

4. Downward wage rigidity $\dot{W}_t = \gamma (\bar{W}_t - W_t)$ if $\bar{W}_t < W_t$
A Simple Model with Wage Rigidity

Time is continuous and indexed by $t$

1. Labor market w/ fixed set of workers, $i \in I$, and plants, $j \in J$

2. Plant $j$ employment equals labor demand at $t$: $E_{jt} = \phi_{jt} W_t^{-\sigma}$
   - $\Rightarrow E_t = \Phi_t W_t^{-\sigma}$ where $\Phi_t \equiv \sum_{j \in J} \phi_{jt}$
   - Btw $t$ and $t + dt$, fraction $\lambda dt$ matches exogenously destroyed $\Rightarrow \lambda_{jt} = \max\{\lambda, -\dot{E}_{jt}/E_{jt}\}$

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4. Downward wage rigidity $\dot{W}_t = \gamma (\bar{W}_t - W_t)$ if $\bar{W}_t < W_t$
A Simple Model with Wage Rigidity

Time is continuous and indexed by $t$

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2. Plant $j$ employment equals labor demand at $t$: $E_{jt} = \phi_{jt} W_t^{-\sigma}$

3. Workers are either employed or unemployed: $E_t + U_t = N$
   - If employed in $j$: wage $W_t$ + endogenous probability of separation $\lambda_{jt} dt$
   - If unemployed: endogenous probability $\kappa_t dt$ of switching to employment at $t + dt$
   - Job-finding rate: $\kappa_t = \max \left\{ 0, \frac{\dot{E}_t + \lambda_t E_t}{U_t} \right\}$ with $\lambda_t = \sum_{j \in J} \lambda_{jt} \frac{E_{jt}}{E_t}$

4. Downward wage rigidity $\dot{W}_t = \gamma (\bar{W}_t - W_t)$ if $\bar{W}_t < W_t$
A Simple Model with Wage Rigidity

Time is continuous and indexed by $t$

1. Labor market w/ fixed set of workers, $i \in \mathcal{I}$, and plants, $j \in \mathcal{J}$

2. Plant $j$ employment equals labor demand at $t$: $E_{jt} = \phi_{jt} W_t^{-\sigma}$

3. Workers are either employed or unemployed: $E_t + U_t = N$

4. Downward wage rigidity \[ \dot{W}_t = \gamma (\bar{W}_t - W_t) \]
   
   ▶ \[ \bar{W}_t \equiv (N/\Phi_t)^{-1/\sigma} \] is market-clearing wage
   
   ▶ $\gamma \geq 0$ determines speed of wage adjustment

If $\bar{W}_t < W_t$
Our Comparative Static Exercise

• Suppose that market is initially in steady state at $t = 0$
  ▶ $W_0 = \overline{W}_0 \implies E_0 = N$

• Then at $t = 0$, there is a one-time, permanent negative labor demand shock that differentially affects plants—call it the “USSR shock”
  ▶ Labor demand parameter for plant $j$ falls from $\phi_j$ to $\phi'_j \equiv (1 - s_j) \phi_j$
  ▶ Worker exposure is equal to exposure of her plant $s_i$
  ▶ Market exposure is equal to average $S \equiv \sum_{j \in J} s_j(E_j/0)/E_0 = \sum_{i \in I} s_i/E_0$

• In response to the USSR Shock:
  ▶ How does market exposure affect the path of market-level wages and employment?
  ▶ How do market and worker exposures affect the path of worker-level employment and earnings?
Proposition 1. In response to the USSR shock, more exposed markets experience

1. declines in wages, with slow adjustment downward toward a new lower market-clearing wage

2. declines in employment, with jump down at impact before slow adjustment upward toward full employment

Proposition 2. In response to the USSR shock, more exposed workers experience

1. declines in expected employment, with larger declines in more exposed markets

2. declines in expected earnings, with larger declines in more exposed markets if wages are sufficiently rigid
Predicted Impact of USSR Shock with Wage Rigidity

**Proposition 1.** In response to the USSR shock, *more exposed markets* experience

1. **declines in wages**, with *slow adjustment downward* toward a new lower market-clearing wage

2. **declines in employment**, with *jump down at impact before slow adjustment upward* toward full employment

**Proposition 2.** In response to the USSR shock, *more exposed workers* experience

1. **declines in expected employment**, with *larger declines in more exposed markets*

2. **declines in expected earnings**, with *larger declines in more exposed markets if wages are sufficiently rigid*
Proposition 1. In response to the USSR shock, more exposed markets experience

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Wage Rigidity as Driver of Earnings Dynamics (Part II: Empirics)
Exposure(s) to Trade and Employment Dynamics

Triple-Difference Specification

\[ \Delta n_{it} = \beta_t s_i + \gamma_t (s_i \times S_m) + \text{Controls}_t \zeta_t + \epsilon_{it} \]

Direct effect of worker exposure \((s_i)\) on employment

Interaction effect of worker and market exposure \((s_i \times S_m)\) on employment

- In line with Proposition 2: More exposed workers experience declines in employment, with larger declines in more exposed markets
Direct Effect of Market Exposure
Double-Difference Specification (Drop Municipality Dummies in Controls)

\[ \Delta n_{it} = \beta_t S_m + \text{Controls}' \zeta_t + \epsilon_{it} \quad \text{and} \quad \Delta w_{it} = \beta_t S_m + \text{Controls}' \zeta_t + \epsilon_{it} \]

- In line with Proposition 1: Wages drop more in the long-run than short-run.
  Employment drops more in short-run than long-run.
Concluding Remarks

• How do local labor markets shape the response to trade shocks?
  ▶ Hypothesis #1: Workers exposed to negative trade shocks fare equally poorly across regions
  ▶ **Hypothesis #2:** There is something systematically different about experience of exposed workers in the most negatively affected markets

• Worker exposure to USSR shock lowers earnings throughout the post period, but persistently more so in more exposed markets, a form of **local scarring**

• We have developed a model of labor-market dynamics w/ downward **wage rigidity** that rationalizes our empirical findings and make additional predictions
  ▶ Predictions are intuitive and supported in the data, but very different than those of workhorse dynamic trade models
  ▶ Point towards new structural determinants of distributional impact of trade:
    ▶ **Speed of wage adjustment**: Has low US inflation rate magnified China Shock?
    ▶ **Job destruction and creation rates**: Has decline in business US dynamism magnified the distributional impact of China shock as well?
Appendix
### Digitizing export records

<table>
<thead>
<tr>
<th>Date</th>
<th>Product Code</th>
<th>Currency</th>
<th>Value</th>
<th>Destination</th>
<th>Exporting Firm</th>
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<tr>
<td>30.1.1989</td>
<td>94.06.00</td>
<td>SUR</td>
<td>56 000</td>
<td>SNTL</td>
<td>Palmera Oy</td>
</tr>
<tr>
<td></td>
<td>48.23</td>
<td>&quot;</td>
<td>2 365</td>
<td>&quot;</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>94.06</td>
<td>&quot;</td>
<td>61 580</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>94.06</td>
<td>&quot;</td>
<td>168 270</td>
<td>&quot;</td>
<td>Thomesto Oy/</td>
</tr>
<tr>
<td></td>
<td>59.09.00</td>
<td>SUR</td>
<td>41 170</td>
<td>&quot;</td>
<td>VV-Auto Oy</td>
</tr>
<tr>
<td></td>
<td>48.14.20</td>
<td>&quot;</td>
<td>39 820</td>
<td>&quot;</td>
<td>Oy Maan Auto Ab</td>
</tr>
<tr>
<td></td>
<td>87.03.23</td>
<td>FIM</td>
<td>73 800</td>
<td>&quot;</td>
<td>Oy Veho Ab</td>
</tr>
<tr>
<td></td>
<td>87.03.23</td>
<td>FRF</td>
<td>75 045</td>
<td>&quot;</td>
<td>Korpivaara Oy</td>
</tr>
<tr>
<td></td>
<td>87.03.32</td>
<td>FIM</td>
<td>88 000</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>87.03.23</td>
<td>&quot;</td>
<td>113 792</td>
<td>&quot;</td>
<td>WSOY</td>
</tr>
<tr>
<td></td>
<td>87.03.23</td>
<td>&quot;</td>
<td>48 800</td>
<td>&quot;</td>
<td>Ultico Oy/</td>
</tr>
<tr>
<td></td>
<td>49.01.99</td>
<td>SUR</td>
<td>69 514</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>61.04</td>
<td>&quot;</td>
<td>94 000</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>62.11.43</td>
<td>&quot;</td>
<td>230 000</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
How complete are recorded transactions?

- Office of Licenses:
  - Info on 3,380 transactions w/ value of 3.7 billion (in 2010 euros)

- NBER-UN:
  - Finland’s exports to the USSR in 1989 were 4.2 billion
Linking export data to LDPM

- LDPM details:
  - 1989 sampling frame of LDPM: all manufacturing plants w/ ≥ 5 employees
  - Firms legally required to answer survey

- Link firms in Office of Licenses to firms in LDPM using either
  - firm names and product codes
  - or annual reports of export cartels

- Link 71% of total value in export data to plants included in LDPM

- Missing construction, wholesale, trading companies not in LDPM
### Table A.1: LDPM Plants by USSR Export Intensity, 1989

<table>
<thead>
<tr>
<th>A: Plant characteristics</th>
<th>All</th>
<th>0%</th>
<th>0–10%</th>
<th>10–50%</th>
<th>50–100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross output</td>
<td>8,207</td>
<td>4,991</td>
<td>33,860</td>
<td>38,277</td>
<td>15,615</td>
</tr>
<tr>
<td>Value-added</td>
<td>2,770</td>
<td>1,725</td>
<td>11,140</td>
<td>11,906</td>
<td>6,013</td>
</tr>
<tr>
<td>Number of workers</td>
<td>58.9</td>
<td>38.3</td>
<td>221.8</td>
<td>245.7</td>
<td>144.0</td>
</tr>
<tr>
<td>Value-added per worker</td>
<td>44.0</td>
<td>42.2</td>
<td>58.5</td>
<td>45.7</td>
<td>41.0</td>
</tr>
<tr>
<td>Capital / labor ratio</td>
<td>60.3</td>
<td>59.2</td>
<td>70.5</td>
<td>57.1</td>
<td>41.5</td>
</tr>
<tr>
<td>Plant age</td>
<td>10.5</td>
<td>10.2</td>
<td>12.9</td>
<td>12.6</td>
<td>12.5</td>
</tr>
<tr>
<td>Multi-plant firm</td>
<td>0.31</td>
<td>0.25</td>
<td>0.82</td>
<td>0.67</td>
<td>0.58</td>
</tr>
<tr>
<td>Share of output exported to the USSR</td>
<td>0.01</td>
<td>0.00</td>
<td>0.02</td>
<td>0.24</td>
<td>0.82</td>
</tr>
</tbody>
</table>

### B: Group characteristics

| Share of output | 1.00 | 0.54 | 0.39 | 0.06 | 0.01 |
| Share of workers | 1.00 | 0.58 | 0.36 | 0.05 | 0.01 |
| Share of USSR exports | 1.00 | 0.00 | 0.30 | 0.44 | 0.26 |

| No. of plants | 6,865 | 5,989 | 734  | 99   | 43   |
| No. of workers | 404,462 | 229,507 | 162,787 | 24,327 | 6,192 |

Notes: This table reports how characteristics of LDPM plants vary with their export intensity (Panel a) as well as the shares of output, employment, and USSR exports accounted by groups of plants with different export intensity (Panel b).
### Table A.3: Worker Characteristics by Worker-Level Exposure to USSR Shock, 1989

<table>
<thead>
<tr>
<th>A: Employer characteristics</th>
<th>All</th>
<th>0%</th>
<th>0–10%</th>
<th>10–50%</th>
<th>50–100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual earnings</td>
<td>26,517</td>
<td>26,228</td>
<td>28,493</td>
<td>28,412</td>
<td>27,910</td>
</tr>
<tr>
<td></td>
<td>(7,430)</td>
<td>(7,738)</td>
<td>(4,328)</td>
<td>(4,611)</td>
<td>(5,235)</td>
</tr>
<tr>
<td>Output (LDPM)</td>
<td>67.4</td>
<td>34.7</td>
<td>115.3</td>
<td>95.5</td>
<td>60.8</td>
</tr>
<tr>
<td></td>
<td>(155.6)</td>
<td>(167.0)</td>
<td>(134.2)</td>
<td>(78.0)</td>
<td>(41.5)</td>
</tr>
<tr>
<td>Capital-labor ratio (LDPM)</td>
<td>102.8</td>
<td>99.1</td>
<td>111.0</td>
<td>94.1</td>
<td>75.3</td>
</tr>
<tr>
<td></td>
<td>(220.1)</td>
<td>(263.0)</td>
<td>(157.6)</td>
<td>(83.0)</td>
<td>(50.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B: Worker socio-demographics</th>
<th>Year of birth</th>
<th>1953.8</th>
<th>1953.9</th>
<th>1953.2</th>
<th>1953.2</th>
<th>1953.3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(5.9)</td>
<td>(5.9)</td>
<td>(5.7)</td>
<td>(5.8)</td>
<td>(5.4)</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>0.35</td>
<td>0.36</td>
<td>0.26</td>
<td>0.28</td>
<td>0.31</td>
</tr>
<tr>
<td>First language Finnish</td>
<td></td>
<td>0.95</td>
<td>0.94</td>
<td>0.97</td>
<td>0.96</td>
<td>0.97</td>
</tr>
<tr>
<td>First language Swedish</td>
<td></td>
<td>0.05</td>
<td>0.06</td>
<td>0.03</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>Other first language</td>
<td></td>
<td>0.003</td>
<td>0.003</td>
<td>0.002</td>
<td>0.001</td>
<td>0.004</td>
</tr>
<tr>
<td>Less than secondary/unknown degree</td>
<td></td>
<td>0.32</td>
<td>0.32</td>
<td>0.33</td>
<td>0.30</td>
<td>0.23</td>
</tr>
<tr>
<td>Lower secondary degree</td>
<td></td>
<td>0.37</td>
<td>0.37</td>
<td>0.42</td>
<td>0.45</td>
<td>0.44</td>
</tr>
<tr>
<td>Upper secondary degree</td>
<td></td>
<td>0.20</td>
<td>0.20</td>
<td>0.14</td>
<td>0.14</td>
<td>0.17</td>
</tr>
<tr>
<td>Lower tertiary degree</td>
<td></td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Higher tertiary degree</td>
<td></td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.07</td>
</tr>
<tr>
<td>General, arts or teaching degree</td>
<td></td>
<td>0.06</td>
<td>0.06</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Business degree</td>
<td></td>
<td>0.16</td>
<td>0.17</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>Technical degree</td>
<td></td>
<td>0.36</td>
<td>0.34</td>
<td>0.51</td>
<td>0.55</td>
<td>0.62</td>
</tr>
<tr>
<td>Degree in other fields</td>
<td></td>
<td>0.10</td>
<td>0.11</td>
<td>0.05</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Degree unknown / missing</td>
<td></td>
<td>0.32</td>
<td>0.32</td>
<td>0.33</td>
<td>0.30</td>
<td>0.23</td>
</tr>
<tr>
<td>Annual earnings</td>
<td></td>
<td>28,354</td>
<td>28,260</td>
<td>29,017</td>
<td>28,823</td>
<td>28,828</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(13,101)</td>
<td>(13,412)</td>
<td>(10,711)</td>
<td>(10,693)</td>
<td>(11,842)</td>
</tr>
</tbody>
</table>

| C: Sector of employment      | Manufacturing | 0.36 | 0.26 | 0.98 | 1.00 | 1.00 |
|                              |               |     |     |     |     |     |
| Observations                 |               | 627,070 | 546,055 | 67,714 | 10,459 | 2,842 |
Exposure(s) to Trade and Earnings Dynamics
Triple-Difference Specification (Baseline)

Direct effect of worker exposure ($s_i$)
Exposure(s) to Trade and Earnings Dynamics
Triple-Difference Specification (Relative Earnings)

Interaction effect of worker and market exposure ($s_i \times S_m$) on relative earnings
Interaction effect of worker and market exposure ($s_i \times S_m$) on earnings
Interaction effect of worker and market exposure ($s_i \times S_m$) on earnings
Interaction effect of worker and market exposure ($s_i \times S_m$) on earnings

Exposure(s) to Trade and Earnings Dynamics
Triple-Difference Specification (Winsorizing Market Exposure)
Exposure(s) to Trade and Employment Dynamics

Triple-Difference Specification (Alternative Worker Controls)

Interaction effect of worker and market exposure \((s_i \times S_m)\), with fewer controls

```
Controlling for:
- Municipality FE
- + employer characteristics
- + worker characteristics
- + manufacturing (baseline)
```

Interaction effect of worker and market exposure \((s_i \times S_m)\), with extra controls

```
Baseline
- Baseline + 2-digit industry
- Baseline + \(s_i^2\)
- Baseline + \(s_i^{*}\) (Municipality characteristics in 1989)
```
• In discrete time, probability unemployed worker at $t$ is employed at $t + \Delta$:

$$\kappa_t \Delta = \max \left\{ 0, \frac{E_{t+\Delta} - \sum_{j \in J} (1 - \lambda_j \Delta) E_{jt}}{U_t} \right\}$$

• As $\Delta$ goes to zero (and omitting the max...)

$$\kappa_t \Delta \simeq \frac{E_t + \Delta E'_t - \sum_{j \in J} (1 - \lambda \Delta) E_{jt}}{U_t} = \frac{\Delta E'_t + \sum_{j \in J} \lambda_j \Delta E_{jt}}{U_t}$$

which gives

$$\kappa_t = \frac{\dot{E}_t + \sum_{j \in J} \lambda_j E_{jt}}{U_t}$$