Exposure(s) to Trade and Earnings Dynamics

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December 1, 2021
The Money and Banking Workshop
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Questions

- **Trade shocks have local effects** Topolova (2010); ADH (2013); Kovak (2013); ...

- **How do local labor markets shape the response to trade shocks?**
  - Do workers exposed to bad trade shocks fair equally poorly across regions?
  - Or is there something systematically different about the experience of negatively shocked workers in the most negatively affected markets?

- **The answers to these questions shape the**
  - evaluation of the distributional consequences of international trade
  - design of policies best suited to address its consequences, e.g.
    - ✴ trade adjustment assistance programs targeting displaced workers
    - ✴ place-based policies additionally targeting the regions where they live/work
The Setting

Massive Trade Shock

- The USSR was Finland’s main trade partner
- Dec. 6, 1990: USSR unilaterally, unexpectedly cancels the Finnish trade deal

Measuring Exposures

- We digitize Finnish firm-level reports of transactions w/ the USSR in 1989
- We link this to employer-employee data, allowing us to measure
  1. worker-level exposure: share of employer’s total sales exported to USSR in 1989
  2. market-level exposure: average worker exposure in municipality in 1989

We study how the earnings trajectories of Finnish workers vary w/ worker-level exposure and how this varies w/ the exposure of their local labor market
Road Map

1 Background
   ▶ Collapse of the Finnish-Soviet trade agreement
   ▶ Market-level exposure to the USSR shock
   ▶ Market-level incidence of the USSR shock

2 Analytically characterize worker-level earnings dynamics as function of exposures
   ▶ Model features heterogeneous worker exposures and downward wage rigidity
   ▶ In response to a one-time, permanent negative export shock
     ★ more exposed workers experience earnings declines at all future dates
     ★ this decline is greater in more exposed markets if wages are sufficiently rigid

3 Main empirical results:
   ▶ More exposed workers experience greater reductions in earnings
   ▶ Negative effect of worker exposure much larger and more persistent in more exposed labor markets (a form of local scarring)
Most-Closely Related Literature

- USSR-Finland trade relationship and Finnish Great Depression: Goridnichenko et al. (2012)

- Labor-demand shocks and worker-level earnings dynamics:
  1. Market-level exposure:
     - Trade shocks: Autor et al. (2014)
     - Great recession: Yagan (2019)
     - We also observe more granular worker-level exposure, allowing us to study whether workers directly exposed to a shock fair equally poorly across markets
  2. Worker-level exposure:
     - Displacement: Jacobson et al. (1993), Couch and Placzek (2010), ...
     - ... over the business cycle: Farber (2016), Davis and von Wachter (2011), Schwandt and von Wachter (2019)
     - We compare workers who differ in terms of ex-ante characteristics
     - We identify differential effect of worker-level exposure w/in labor markets
     - Our results are the spatial counterpart of the business cycle analysis
Background
The Finnish-USSR Trade Arrangement and its Demise

- Series of five-year, bilateral trade agreements starting in 1951
  - Originated from war repatriations paid in commodities to USSR after WWII
  - Trade was required to be annually balanced
  - Finland imported energy (world price) exported manufactures (negotiated high price)
    - Highest export share sectors: ships, trains, textiles, leather, footwear
  - Products often produced to Soviet specifications ⇒ hard to sell elsewhere

- USSR unilaterally cancelled the agreement on Dec 6th, 1990

Finnish manufacturers taken by surprise

- Sutela (2014, 134): “That it was evident that the Soviet Union was collapsing was not of any importance: there were friends at the Soviet Ministry of Foreign Trade who claimed that everything would be fine after a short period of uncertainty.”
- None of the economic forecasts published in 1990 anticipated that exports to the USSR would collapse in the next year (Möttönen, 2002)
Market-Level Exposure to the USSR Shock

- Firms required to notify Office of Licenses of all transactions with the Soviet Union
- Transactions published in biweekly reports include info on: exporting firm, 6-digit product, value, currency, date of the transaction
- We have digitalized all of these reports for the year 1989 and linked to plants in the Longitudinal Data on Plants in Finnish Manufacturing (LDPM)
- For each plant $j$, we define exposure to the USSR trade shock as

$$s_j \equiv \frac{x_{j,89}}{q_{j,89}}$$

where $x_{j,89} =$ value of exports to the USSR and $q_{j,89} =$ gross output

- Municipality $m$ exposure to the USSR trade 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
Market-Level Exposure to the USSR Shock ($\times 100$)

The map illustrates the exposure to the USSR shock at the market level, with varying intensities indicated by different colors. The colors represent different intensity ranges, with darker shades indicating higher exposure.
Market-Level Incidence of the USSR Shock

- Estimate $\Delta Y_{mt} = \beta_t S_m + \text{Controls}'_m \zeta_t + \varepsilon_{mt}$
  - $\Delta Y_{mt} \equiv Y_{mt} - Y_m^{pre}$
  - Vector of municipality controls as measured in 1989:
    1. share of municipality employment w/in manufacturing sector
    2. share of working-age population (18-64) with at least a secondary education
    3. average age of the working-age population (both measured in 1989)

**log of average earnings**
(of the working-age population)

**Unemployment rate**
(times 100)
Exposure to Trade and Earnings Dynamics: Theory
Setup

Time is continuous and indexed by \( t \)

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

2. Plant \( j \) employment equals labor demand at \( t \): \( E_{jt} = \phi_{jt} W_{mt}^{-\sigma} \)

3. Workers are either employed or unemployed: \( E_{mt} + U_{mt} = N_m \)

4. Downward wage rigidity \( \dot{W}_{mt} = \gamma (\bar{W}_{mt} - W_{mt}) \) \( \text{if } \bar{W}_{mt} < W_{mt} \)
Setup

Time is continuous and indexed by $t$

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

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

3. Workers are either employed or unemployed: $E_{mt} + U_{mt} = N_m$

4. Downward wage rigidity $\dot{W}_{mt} = \gamma(\bar{W}_{mt} - W_{mt})$ if $\bar{W}_{mt} < W_{mt}$
Setup

Time is continuous and indexed by $t$

1. Labor market $m$ w/ fixed set of workers, $i \in I_m$, and plants, $j \in J_m$

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

3. Workers are either employed or unemployed: $E_{mt} + U_{mt} = N_m$
   - If employed in $j$: wage $W_{mt}$ + endogenous probability of separation $\lambda_{jt} dt$
   - If unemployed: endogenous probability $\kappa_{mt} dt$ of switching to employment at $t + dt$
   - Job-finding rate: $\kappa_{mt} = \max\left\{0, \frac{\dot{E}_{mt} + \lambda_{mt} E_{mt}}{U_{mt}}\right\}$ with $\lambda_{mt} = \sum_{j \in J_m} \lambda_{jt} \frac{E_{jt}}{E_{mt}}$

4. Downward wage rigidity $\dot{W}_{mt} = \gamma (\overline{W}_{mt} - W_{mt})$ if $\overline{W}_{mt} < W_{mt}$
Setup

Time is continuous and indexed by \( t \)

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

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4. Downward wage rigidity \( \dot{W}_{mt} = \gamma (\bar{W}_{mt} - W_{mt}) \) if \( \bar{W}_{mt} < W_{mt} \)
   - \( \bar{W}_{mt} \equiv (N_m/\Phi_{mt})^{-1/\sigma} \) is market-clearing wage
   - \( \gamma \geq 0 \) determines speed of wage adjustment
USSR Shock and Market-Level Unemployment and Wages

- Market in steady state at $t = 0$: $W_{m0} = \overline{W}_{m0}$  \Rightarrow  $E_{m0} = N_m$

- At $t = 0$, there is a one-time, permanent negative labor demand shock
  - Labor demand parameter for plant $j$ falls from $\phi_j$ to $\phi_j' \equiv (1 - s_j) \phi_j$
  - “Worker-level exposure” $s_i$ is the same as exposure of her plant
  - “Market-level exposure” is $S_m \equiv \sum_{j \in J_m} s_j (E_{j0}/E_{m0}) = \sum_{i \in I_m} s_i / E_{m0}$

- $\overline{W}_{m0} = (N_m/\Phi_m)^{-1/\sigma}$ falls to $\overline{W}_{m0^+} = (N_m/\Phi_m')^{-1/\sigma}$ with $\Phi_m' = \Phi_m (1 - S_m)$

- $W_{mt}$ is solution to first-order linear ODE (initial condition $W_{m0} = \overline{W}_{m0}$)

\[
W_{mt} = \left( \frac{N_m}{\Phi_m} \right)^{-\frac{1}{\sigma}} \left[ e^{-\gamma t} + (1 - e^{-\gamma t})(1 - S_m)^{\frac{1}{\sigma}} \right]
\]

\[
U_{mt} = N_m \left\{ 1 - (1 - S_m) \left[ e^{-\gamma t} + (1 - e^{-\gamma t})(1 - S_m)^{\frac{1}{\sigma}} \right]^{-\sigma} \right\}
\]

- Unemployment rate $U_{mt}/N_m$ jumps up to $S_m$ on impact and declines over time; is strictly increasing in $S_m$ at any date $t > 0$
Worker-level earnings for any $t > 0$

- Worker $i$ expected earnings at any $t > 0$ is $y_{it} = W_{mt} \pi_{it}$

- $\pi_{it}$: probability worker $i \in I_m$ is employed by any plant $j \in J_m$ at date $t > 0$
Worker-level earnings for any $t > 0$

- Worker $i$ expected earnings at any $t > 0$ is $y_{it} = W_{mt} \pi_{it}$
- $\pi_{it}$: probability worker $i \in I_m$ is employed by any plant $j \in J_m$ at date $t > 0$

1. Immediately following the shock, discrete drop: $\pi_{i0+} = 1 - s_i$
2. Ever thereafter: $\dot{\pi}_{it} = \kappa_{mt}(1 - \pi_{it}) - \lambda \pi_{it} = \kappa_{mt} - (\lambda + \kappa_{mt}) \pi_{it}$ for all $i$

$\Rightarrow$ employment probability at date $t > 0$:

$$\pi_{it} = 1 - s_i e^{-\int_0^t (\lambda + \kappa_{mv}) dv} - \lambda \int_0^t e^{-\int_v^t (\lambda + \kappa_{mz}) dz} dv$$
Worker-level earnings for any $t > 0$

<table>
<thead>
<tr>
<th>Proposition</th>
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<tbody>
<tr>
<td><em>In response to one-time, permanent, negative shock at</em> $t = 0$</td>
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<tr>
<td>1. <em>more exposed workers always experience declines in expected earnings</em></td>
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</table>

1. More exposed workers more likely to lose job at $t = 0$, reducing employment rate at all $t > 0$ (and all workers earn the same wage when employed)
Worker-level earnings for any $t > 0$

Proposition

In response to one-time, permanent, negative shock at $t = 0$

1. more exposed workers always experience declines in expected earnings

$$\frac{dy_{it}}{ds_i} < 0 \quad \text{for all } t > 0;$$

2. these declines are larger in more exposed markets if wages sufficiently rigid (low $\gamma$)

$$\frac{d^2 y_{it}}{(ds_i dS_m)} < 0 \quad \text{for all } t > 0$$

but declines can be smaller in more exposed markets if $\gamma$ high

$$\frac{d^2 y_{it}}{(ds_i dS_m)} > 0 \quad \text{for some } t > 0$$

More exposed markets have lower job-finding rates, $\kappa_{mt}$, and wages, $W_{mt}$, at each $t$

- $\kappa_{mt}$-effect magnifies $\downarrow y_{it}$ for workers with greater $s_i$ in markets with higher $S_m$
- $W_{mt}$-effect mitigates $\downarrow y_{it}$ for workers with greater $s_i$ in markets with higher $S_m$
Worker-level earnings for any $t > 0$

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Additional results:
- $d^2 \log y_{it}/(ds_i dS_m) < 0$
- $dy_{it}/dS_m < 0$

Depends only on $\pi_{mt}$
b/c of both $W_{mt}$ and $\pi_{mt}$
Exposure to Trade and Earnings Dynamics: Empirics
Empirical Design

1. Examine incidence of worker exposure, $s_i$, on annual earnings, $y_{it}$
   - Compare changes in the 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 $\Delta y_{it} \equiv y_{it} - \bar{y}_{i}^{\text{pre}}$ and Controls$_i$ is a vector of initial characteristics

2. Study how incidence varies across markets with different exposure, $S_m$
   \[
   \Delta y_{it} = \beta_t s_i + \gamma_t (s_i \times S_m) + \text{Controls}_i' \zeta_t + \varepsilon_{it}
   \]
   - a triple- rather than double-difference strategy
Worker-Level Data

- Main data cover Finland’s working-age population in 1985 and 1988-2004

- Worker-Level Outcomes
  - Primary outcome variable is annual earnings, $y_{it}$
    - total annual wage, salary income reported to Finnish Tax Authority in year $t$
    - winsorized at top 1% within each year

- Worker-level controls
  - Controls for each of the 431 municipalities (where individual worked in 1989)
  - Plant characteristics (where individual worked in 1989)
    - avg pre-shock earnings, plant output*, capital/labor ratio*, avg chicago- and white-collar wages*
      measured only for manuf (missing category for others)
  - Worker socio-demographics
    - birth year, gender, language, education level + field, pre-shock earnings
  - Industry control: manufacturing indicator

- Sample: private sector, high labor force attachment, born 1945-1967
### Table 2: Background characteristics, 1989

<table>
<thead>
<tr>
<th></th>
<th>Baseline sample (1)</th>
<th>All private sector workers (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A: Employer characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average annual earnings</td>
<td>26,517</td>
<td>25,583</td>
</tr>
<tr>
<td></td>
<td>(7,430)</td>
<td>(7,553)</td>
</tr>
<tr>
<td>Average hourly</td>
<td>7.9</td>
<td>7.8</td>
</tr>
<tr>
<td>blue-collar wages (LDPM)</td>
<td>(1.7)</td>
<td>(1.7)</td>
</tr>
<tr>
<td>Average hourly</td>
<td>11.0</td>
<td>10.9</td>
</tr>
<tr>
<td>white-collar wages (LDPM)</td>
<td>(2.1)</td>
<td>(2.2)</td>
</tr>
<tr>
<td>Output (LDPM)</td>
<td>67.4</td>
<td>64.3</td>
</tr>
<tr>
<td></td>
<td>(155.6)</td>
<td>(152.4)</td>
</tr>
<tr>
<td>Capital-labor ratio (LDPM)</td>
<td>102.8</td>
<td>97.7</td>
</tr>
<tr>
<td></td>
<td>(220.1)</td>
<td>(212.3)</td>
</tr>
<tr>
<td><strong>B: Worker Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year of birth</td>
<td>1953.8</td>
<td>1955.1</td>
</tr>
<tr>
<td></td>
<td>(5.9)</td>
<td>(6.5)</td>
</tr>
<tr>
<td>Female</td>
<td>0.35</td>
<td>0.39</td>
</tr>
<tr>
<td>First language Finnish</td>
<td>0.95</td>
<td>0.94</td>
</tr>
<tr>
<td>First language Swedish</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Other first language</td>
<td>0.003</td>
<td>0.003</td>
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<tr>
<td>Less than secondary/unknown degree</td>
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<td>0.30</td>
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<tr>
<td>Lower secondary degree</td>
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<td>0.38</td>
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<tr>
<td>Upper secondary degree</td>
<td>0.20</td>
<td>0.22</td>
</tr>
<tr>
<td>Lower tertiary educadegree</td>
<td>0.05</td>
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</tr>
<tr>
<td>Higher tertiary degree</td>
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<td>0.06</td>
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<tr>
<td>General, arts or teaching degree</td>
<td>0.06</td>
<td>0.07</td>
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<tr>
<td>Business degree</td>
<td>0.16</td>
<td>0.16</td>
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<tr>
<td>Technical degree</td>
<td>0.36</td>
<td>0.34</td>
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<tr>
<td>Degree in other fields</td>
<td>0.10</td>
<td>0.13</td>
</tr>
<tr>
<td>Degree unknown / missing</td>
<td>0.32</td>
<td>0.30</td>
</tr>
<tr>
<td>Annual earnings</td>
<td>28,354</td>
<td>25,336</td>
</tr>
<tr>
<td></td>
<td>(13,101)</td>
<td>(13,483)</td>
</tr>
<tr>
<td><strong>C: Sector of employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.35</td>
<td>0.39</td>
</tr>
<tr>
<td>Observations</td>
<td>627,070</td>
<td>830,639</td>
</tr>
</tbody>
</table>
Worker-Level Exposure

- Exposure measured as in theory (and market-level empirics):
  1. $s_i$: share of 1989 plant’s gross output exported to USSR
  2. $S_m$: average of $s_i$ across workers

- Worker exposure is skewed both because
  1. only manufacturing plants have positive exposure
  2. within manufacturing plants only 13% exported to the USSR in 1989

Distribution of $s_i > 0$ across workers
bottom and top quartile exposure municipalities

![Graph showing distribution of worker exposure](image)
More exposed workers experience declines in earnings:

- Effect peaks in 1992 and 1993, at nadir of Finnish-Soviet trade
  - In 1992, worker at the 90th percentile of exposure experiences €732 ↓ (≈ 3% ↓) in earnings compared to worker at 10th percentile (conditional on $s_i > 0$)
  - Contracts btw 1993-95, but remains negative throughout sample

No evidence of pre-existing differential trends:

- Changes in estimates consistent w/ institutional details of the trade agreement: more exposed workers’ earnings positively covary with oil prices before trade collapse
Baseline Earnings Results

Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)

- Conditional on $s_i \times S_m$
  1. workers w/ higher exposure $s_i$ experienced substantial declines in labor earnings
  2. these declines converge quickly to zero
Baseline Earnings Results

Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)

- More exposed workers experience greater and more persistent earnings declines compared to less exposed workers in more compared to less exposed markets.
- Moving from 10th to 90th percentile of $s_i > 0$ distribution in 1992:
  - in 10th percentile exposure muni: €658 ↓
  - in 90th percentile exposure muni: decline is $\approx 20\%$ larger
Sensitivity Analysis

- Set of Controls
- Relative vs. Absolute Earnings
- Worker Sample
- Measuring Exposure on Attached Sample
- Winsorizing Market Exposure
To this point, we have focused on earnings dynamics.

We have shown that in response to the USSR shock (and consistent with our model):

1. more exposed workers experience greater earnings declines
2. these earnings declines are larger in more exposed markets (local scarring)

An additional theoretical implication is that local scarring arises because more exposed workers are less likely to be re-employed in markets that are more exposed:

\[
\frac{d\pi_{it}}{ds_i} < 0 \quad \text{and} \quad \frac{d^2\pi_{it}}{ds_idS_m} < 0 \quad \text{for all} \quad t > 0
\]

We conclude our empirical analysis by turning to these predictions.
To this point, we have focused on earnings dynamics. We have shown that in response to the USSR shock (and consistent with our model):

1. More exposed workers experience greater earnings declines.
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\]

We conclude our empirical analysis by turning to these predictions.

We measure \(\pi_{it}\) using days employed (Pension Register):

- Does not include information on hours.
- Likely over-states employment of people working irregular shifts.
Employment Results

Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)

- In line with our model and earnings results:
  - Negative impact of worker-level exposure on employment
    - peaks around 1992-1993
    - dissipates in the long-run
Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)

- Although a positive estimate of $\hat{\gamma}_t$ in 1990 (recall shock occurs in December 1990) and 1991, it turns negative thereafter
Conclusions

- What role do local labor markets play in propagating trade shocks?
  - Does recent empirical evidence merely reflect the fact that more exposed markets are inhabited by a greater share of equally affected workers?
  - Or is there something distinct about the experience of workers exposed to trade in the more exposed markets?

- Are trade assistance programs well suited to compensate workers or should such programs inherit characteristics of place-based policies?

- Theoretically, we have characterized analytically how worker- and labor-market-level exposures shape worker-level dynamics in a model with downward wage rigidity.

- Empirically, the negative effect of worker-level exposure is substantially and significantly larger in more exposed labor markets in the short and medium run, a form of local scarring (consistent with the presence of significant wage rigidity).
Appendix
Collapse of Finnish-USSR Trade

The graph shows the USSR export share from 1980 to 2004. Key events highlighted include:
- Exposure measurement (1989)
- Cancellation of the trade agreement (Dec 1990)

The data indicates a significant decrease in the USSR's export share after the trade agreement was cancelled in 1990.
<table>
<thead>
<tr>
<th>Date</th>
<th>Product Code</th>
<th>Valuta</th>
<th>Valuta Amount</th>
<th>Land</th>
<th>Ilmoituksen tekijä</th>
</tr>
</thead>
<tbody>
<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>
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<td>48.23</td>
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<td>61.04</td>
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<td>6 312</td>
<td>&quot;</td>
<td>Kati-Myynti Oy</td>
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<td>73.12.10</td>
<td>&quot;</td>
<td>21 256</td>
<td>&quot;</td>
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<td></td>
<td>94.03</td>
<td>&quot;</td>
<td>47 480</td>
<td>&quot;</td>
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<td>&quot;</td>
<td>509 730</td>
<td>&quot;</td>
<td>Tender Oy, Sotka</td>
</tr>
</tbody>
</table>
Market-Level Exposure to the USSR Shock: Details

- How complete are recorded transactions?
  - info on 3,380 transactions w/ value of 3.7bn (in 2010 euros)
  - Finland’s exports to the USSR in 1989 were 4.2bn according to NBER-UN

- Linking export data to LDPM
  - 1989 sampling frame of LDPM: all manufacturing plants w/ ≥ 5 employees
  - Firms legally required to answer survey, which included questions about inputs, outputs, municipalities in which their plants are located...
  - Link 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

- Plant exposure: \( s_j \equiv \frac{x_{j,89}}{q_{j,89}} \)
  - \( q_{j,89} \): Gross output directly observed in LDPM
  - \( x_{j,89} \) for single-plant firms: Directly observed in Office of Licenses
  - \( x_{j,89} \) for multi-plant firms: Allocate firm-level 6-digit product exports across plants using share of gross-output accounted by plant \( j \) for this product, observed in LDPM
Market-Level Incidence of the USSR Shock

Migration does not appear to be an active adjustment margin over 15-year horizon

No break in the trend immediately following the USSR shock (or after)
In discrete time, probability unemployed worker at $t$ is employed at $t + \Delta$:

$$\kappa_{mt}\Delta = \max \left\{ 0, \frac{E_{mt+\Delta} - \sum_{j \in J_m} (1 - \lambda_{jt}\Delta)E_{jt}}{U_{mt}} \right\}$$

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

$$\kappa_{mt}\Delta \approx \frac{E_{mt} + \Delta E_{mt} - \sum_{j \in J_m} (1 - \lambda\Delta)E_{jt}}{U_{mt}} = \frac{\Delta E_{mt} + \sum_{j \in J_m} \lambda_{jt}\Delta E_{jt}}{U_{t}}$$

which gives

$$\kappa_t = \frac{\dot{E}_{mt} + \sum_{j \in J_m} \lambda_{jt}E_{jt}}{U_{mt}}$$
Set of Controls

Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)

Controlling for:
- Nothing
- Employer characteristics
- Employer and worker characteristics
- Employer and worker characteristics, manufacturing
- Employer and worker characteristics, 2-digit industry
Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)
Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)
Measuring Exposure on Attached Sample

Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)
Winsorizing Market Exposure (top percentile)

Estimated effect of worker-level exposure ($\hat{\beta}_t$)

Estimated interaction effect between worker- and market-level exposures ($\hat{\gamma}_t$)
OLD: Longitudinal Data on Plants in Finnish Manufacturing
LDPM

- info on inputs, outputs, export status etc. for all manufacturing plants with five or more employees, 1974-2011
- covers 74% of manufacturing employment in 1989
- detailed product codes on output for years 1986-1992
- we can link 71% of export monitoring data to LDPM
- 11% of LDPM plants export to the USSR
- among exporters average USSR export share 8% (SD 19%)
OLD: Individual-level data

- Finnish Longitudinal Employer-Employee Data (FLEED)
  - full working age population in 1988-2013
  - plant code, annual earnings, employment status, education, place of residence, family structure, unemployment spells...

- Confederation of Finnish Industries employer-employee data
  - wages and hours for blue-collar workers
  - monthly salaries and contract hours for white-collar workers
  - workers in firms belonging to the Confederation 1980-2013 (20% of total employment, 59% of manufacturing employment in 1989)

- Census data
## OLD: Plant characteristics by exposure in 1989

By share of output exported to the USSR in 1989

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>0%</th>
<th>0–10%</th>
<th>10–50%</th>
<th>50–100%</th>
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<tbody>
<tr>
<td><strong>A: Plant characteristics</strong></td>
<td></td>
<td></td>
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<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>
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<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>
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<tr>
<td>No. 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>
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<tr>
<td>Share of blue-collar workers</td>
<td>0.74</td>
<td>0.74</td>
<td>0.71</td>
<td>0.72</td>
<td>0.73</td>
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<tr>
<td>Blue-collar average wages</td>
<td>8.2</td>
<td>8.1</td>
<td>9.0</td>
<td>8.7</td>
<td>8.6</td>
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<tr>
<td>White-collar average wages</td>
<td>11.8</td>
<td>11.8</td>
<td>12.4</td>
<td>12.0</td>
<td>12.0</td>
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<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>
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<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>
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<tr>
<td>Multiplant firm</td>
<td>0.31</td>
<td>0.25</td>
<td>0.82</td>
<td>0.67</td>
<td>0.58</td>
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<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>
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<td><strong>B: Group characteristics</strong></td>
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<tr>
<td>Share of output</td>
<td>1.00</td>
<td>0.54</td>
<td>0.39</td>
<td>0.06</td>
<td>0.01</td>
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<tr>
<td>Share of workers</td>
<td>1.00</td>
<td>0.58</td>
<td>0.36</td>
<td>0.05</td>
<td>0.01</td>
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<tr>
<td>Share of USSR exports</td>
<td>1.00</td>
<td>0.00</td>
<td>0.30</td>
<td>0.44</td>
<td>0.26</td>
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<tr>
<td>No. of plants</td>
<td>6,865</td>
<td>5,989</td>
<td>734</td>
<td>99</td>
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<tr>
<td>No. of workers</td>
<td>404,462</td>
<td>229,507</td>
<td>162,787</td>
<td>24,327</td>
<td>6,192</td>
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### OLD: Worker characteristics by exposure in 1989

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<tr>
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<th>Manufacturing</th>
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<tr>
<td></td>
<td>By plant exposure</td>
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</tr>
<tr>
<td></td>
<td>All</td>
<td>0%</td>
</tr>
<tr>
<td><strong>A: Demographics</strong></td>
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<tr>
<td>Female</td>
<td>0.28</td>
<td>0.29</td>
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<tr>
<td>Age</td>
<td>35.4</td>
<td>35.2</td>
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<tr>
<td>First language Finnish</td>
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<td>0.95</td>
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<td><strong>C: Level of education</strong></td>
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<td>Less than secondary / unknown</td>
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<td>0.33</td>
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<tr>
<td>Secondary</td>
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<tr>
<td>Advanced vocational</td>
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<td>College</td>
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<td>0.08</td>
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<td><strong>D: Field of education</strong></td>
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<td>Technical</td>
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<td>Other</td>
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<td>Annual earnings</td>
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<td>Earnings growth, 1985–89</td>
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