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

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July 2022

Question

- 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** $\Longrightarrow$ National social programs compensating workers regardless of location well suited (unemployment benefits, trade adjustment assistance)
  - **#2** $\Longrightarrow$ 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

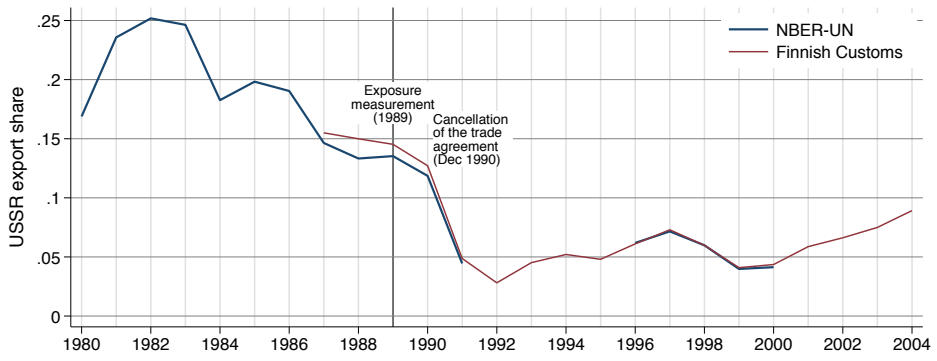
Related Literature

- 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)...
- 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
  - Main empirical results = **spatial counterpart** of the **business cycle** analysis of Farber (2016), Davis and von Wachter (2011), Schwandt and von Wachter (2019)
- 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

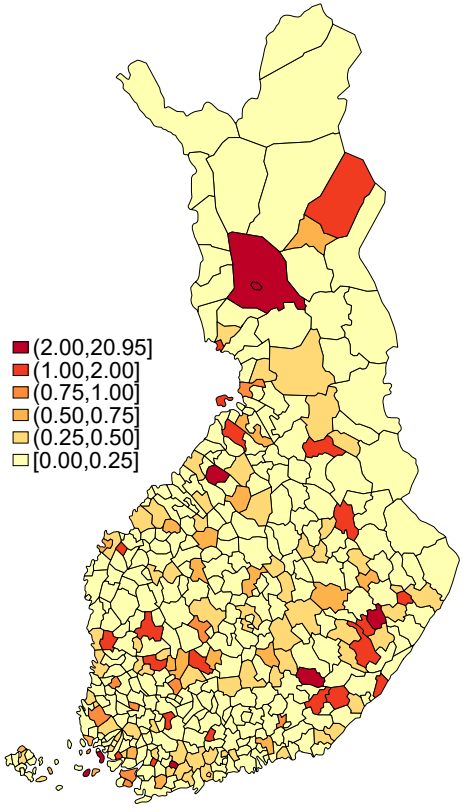
- We start with data on exports to the USSR at the firm-and-product level
  - Firms required to notify Office of Licenses of all transactions w/ Soviet Union
  - Published these transactions in biweekly reports
  - We have digitalized all reports for the year 1989 Digitize
  - $x_{fp,1989}$ = value of exports to USSR of product p by firm f in 1989 Data check 1
- 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) Data check 2
  - info on inputs, outputs, the municipalities in which their plants are located, ...
  - $q_{jp,1989}$ = value of gross output of plant j product p for all j in LDPM
- This allows us to construct plant-level USSR export intensity $s_j \equiv x_{j,1989}/q_{j,1989}$ Plant characteristics - export intensity
  - $q_{j,1989} \equiv \sum_p q_{jp,1989}$ is plant j's total gross output
  - $x_{j,1989} \equiv \sum_p x_{fp,1989} \times (q_{jp,1989}/q_{fp,1989})$ is plant j's (inferred) USSR exports

Market Exposure to the USSR Shock

Municipality m exposure to USSR Shock

$$S_m \equiv \sum_{j \in \mathcal{J}_m} \omega_j s_j$$

with weights equal to the employment share of plant j in market m in 1989

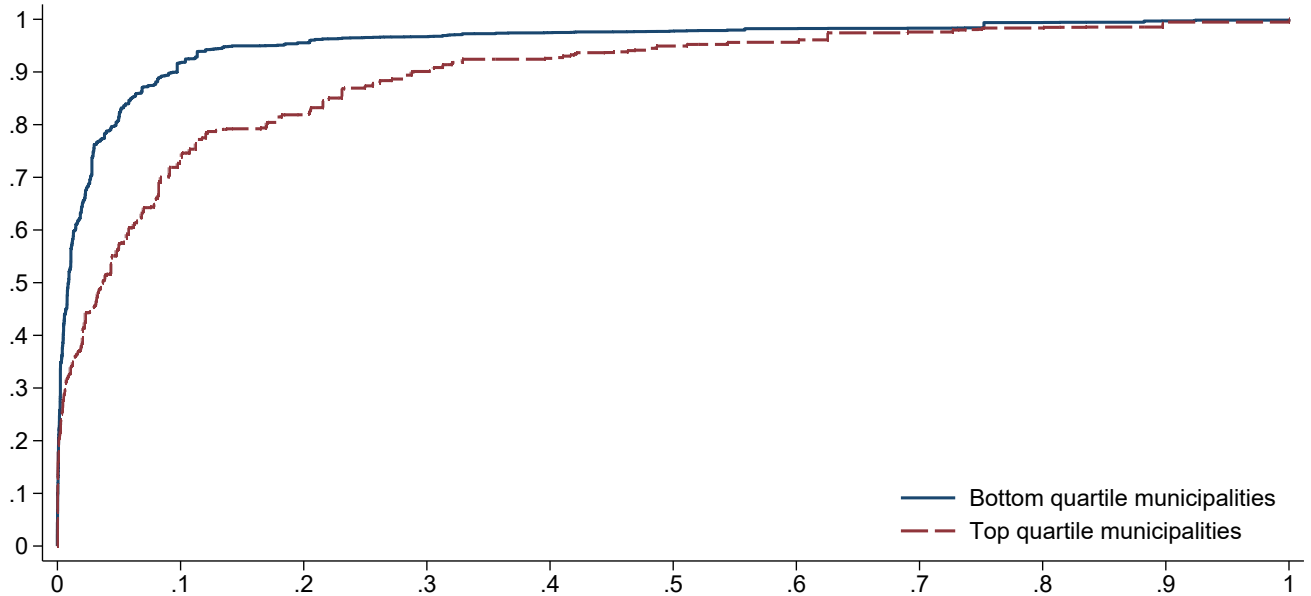


Worker Exposure to the USSR Shock

- 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

Worker characteristics by exposure

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: Study causal relationship btw worker and market exposures, s_i and S_m, and 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 $\Delta y_{it} \equiv y_{it} - \overline{y}_i^{pre}$ and Controls_i is a long vector of initial characteristics

Empirical Design(s)

Goal: Study causal relationship btw worker and market exposures, s_i and S_m, and path of Finnish workers' earnings $y_{i,t}$ over the 1985-2004 period

2. 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

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

Worker Controls and Sample

- Worker Controls:
  - Municipality dummy variables (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 dummy variable
  - Worker Socio-demographics
    - ★ birth year, gender, language, education level + field, pre-shock earnings
- Worker Sample:
  - Private sector
  - High labor force attachment
  - Born 1945-1967

Worker Controls and Sample

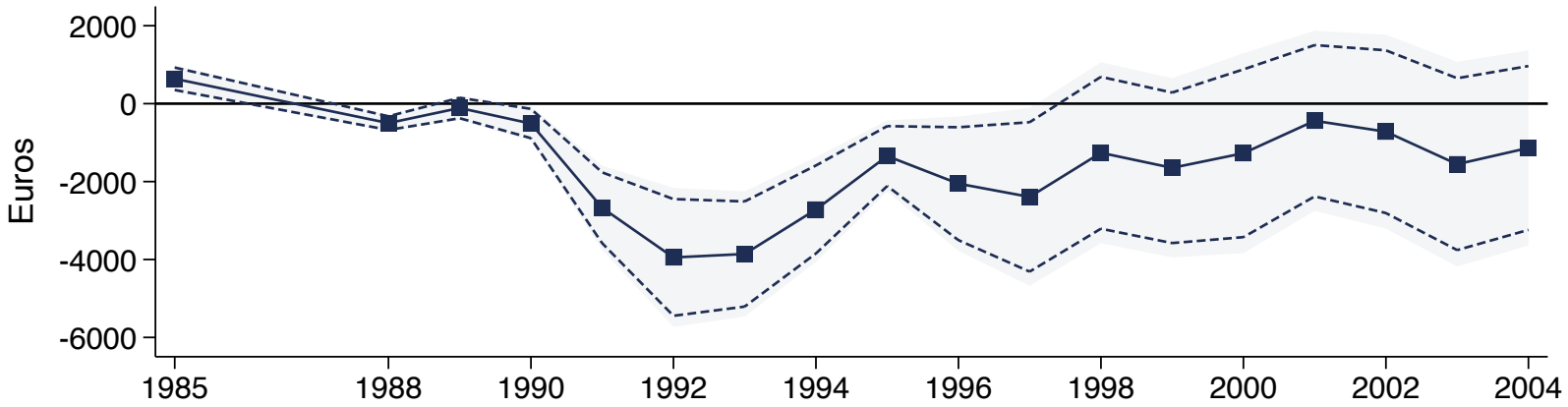
	"Attached workers"			
	Baseline sample (1)	Manu-facturing (2)	Hourly wage (3)	All private sector (4)
A: Employer characteristics				
Average annual earnings	26,517	26,400	26,774	25,583
	(7,430)	(6,018)	(5,211)	(7,553)
Output (LDPM)	67.4	69.2	86.6	64.3
	(155.6)	(158.7)	(173.3)	(152.4)
Capital-labor ratio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

Exposure(s) to Trade and Earnings Dynamics

Double-Difference Specification (Baseline)

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

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 $s_i > 0$), $\approx$ 3% of annual earnings

Exposure(s) to Trade and Earnings Dynamics

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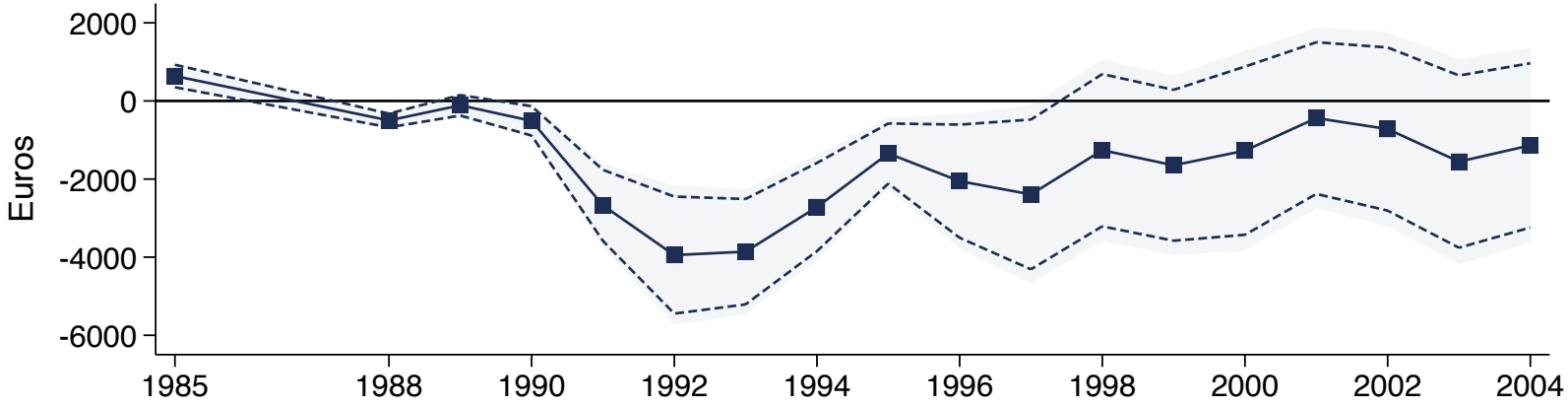


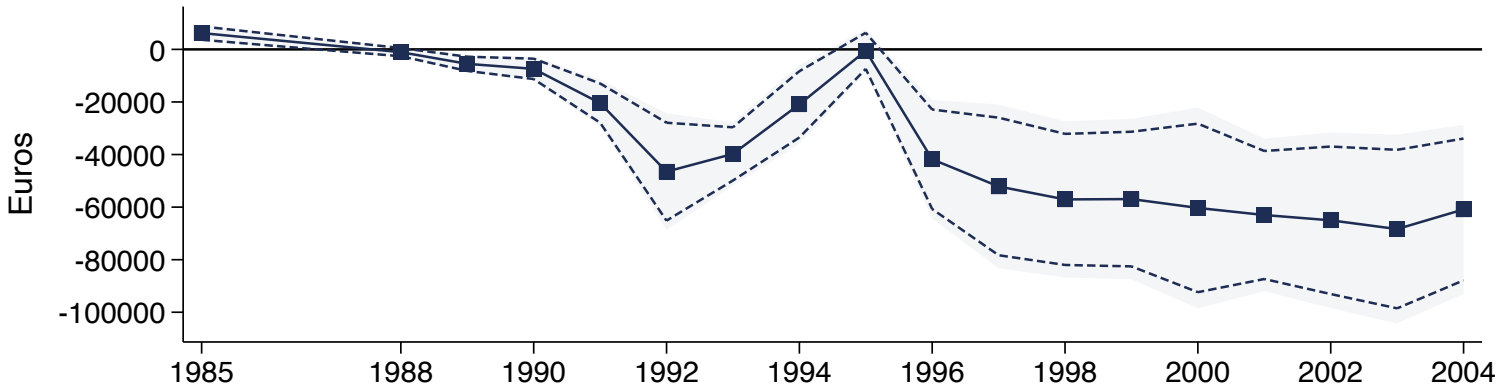
- Another way to interpret the magnitude of β_t is as the RF of a 2SLS regression:
  - 1st stage: regress a dummy for being fired on exposure to the USSR shock
  - 2nd stage: regress earnings on a dummy for being fired similar to regression in mass-layoff literature
- Assume that, consistent with our 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

Direct effect

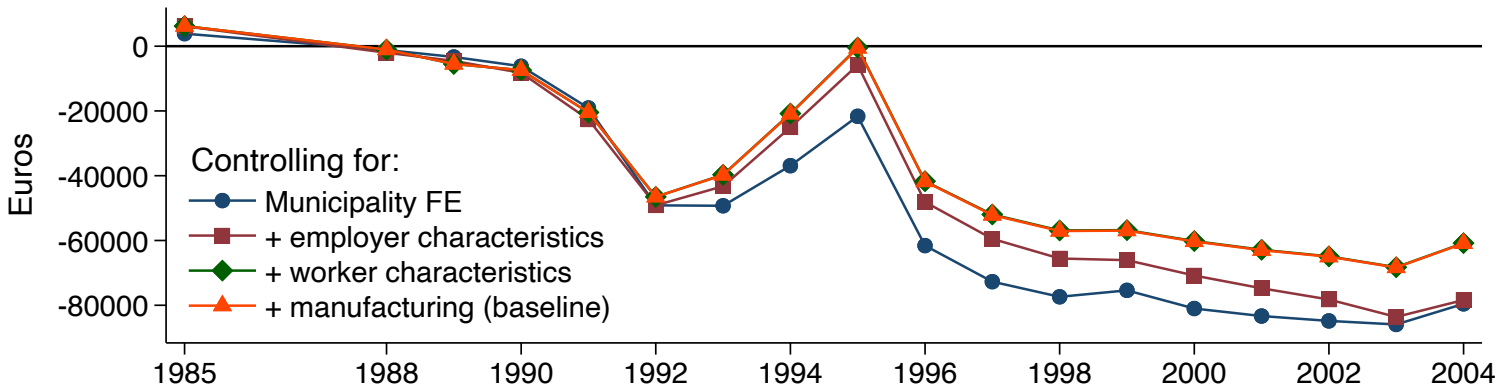
- Moving from 10th to 90th percentile of $s_i > 0$ distribution in 1992:
  - in 10th percentile exposure muni: 652 ↓ euros
  - in 90th percentile exposure muni: decline is ≈ 10% larger

- 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)

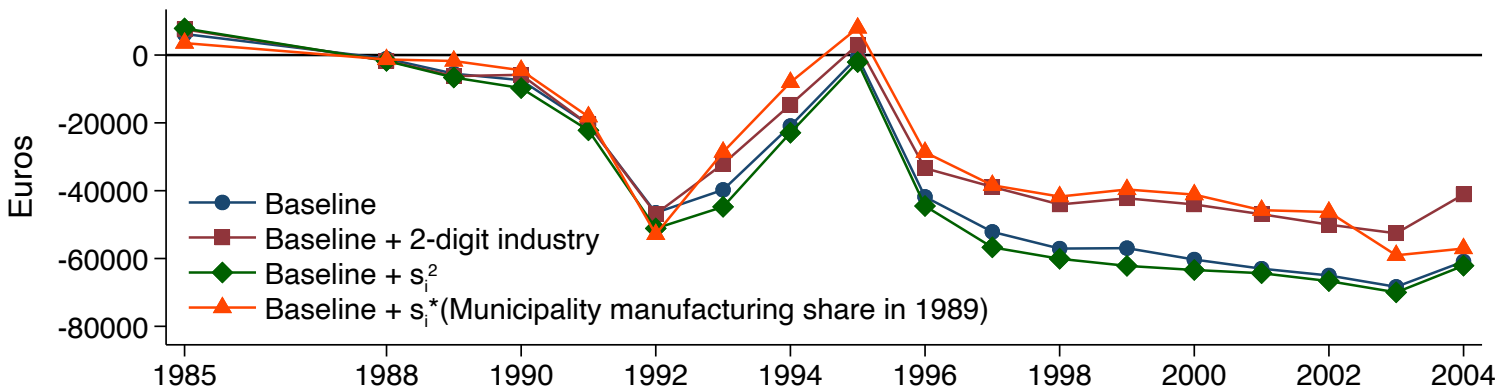
Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Alternative Worker Controls)

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



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



Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Other Robustness Checks)

- Relative vs. Absolute Earnings Go
- Alternative Worker Samples Go
- Alternative Measures of Market Exposure Go

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 $\dot{W}_t = \gamma(\overline{W}_t - W_t)$ if $\overline{W}_t < W_t$

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   - $\Rightarrow E_t = \Phi_t W_t^{-\sigma}$ where $\Phi_t \equiv \sum_{j \in \mathcal{J}} \phi_{jt}$
   - Btw t and $t + dt$, fraction λdt matches exogenously destroyed $\Rightarrow \lambda_{jt} = \max\{\lambda, -\dot{E}_{jt}/E_{jt}\}$
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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 $\lambda_t = \sum_{j \in \mathcal{J}} \lambda_{jt} \frac{E_{jt}}{E_t}$ Derivation
4. Downward wage rigidity $\dot{W}_t = \gamma(\overline{W}_t - W_t)$ if $\overline{W}_t < W_t$

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   - $\overline{W}_t \equiv (N/\Phi_t)^{-1/\sigma}$ is market-clearing wage
   - $\gamma \geq 0$ determines speed of wage adjustment

Our Comparative Static Exercise

- Suppose that market is initially in steady state at $t = 0$
  - $W_0 = \overline{W}_0 \Longrightarrow E_0 = N$
- 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 ϕ_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 $S \equiv \sum_{j \in \mathcal{J}} s_j (E_{j0}/E_0) = \sum_{i \in \mathcal{I}} s_i / E_0$
- 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?

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*

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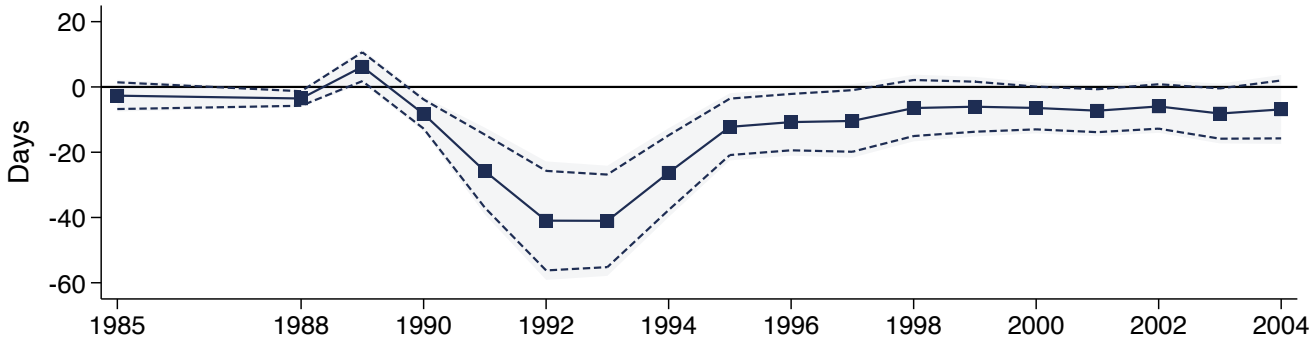
Wage Rigidity as Driver of Earnings Dynamics (Part II: Empirics)

Exposure(s) to Trade and Employment Dynamics

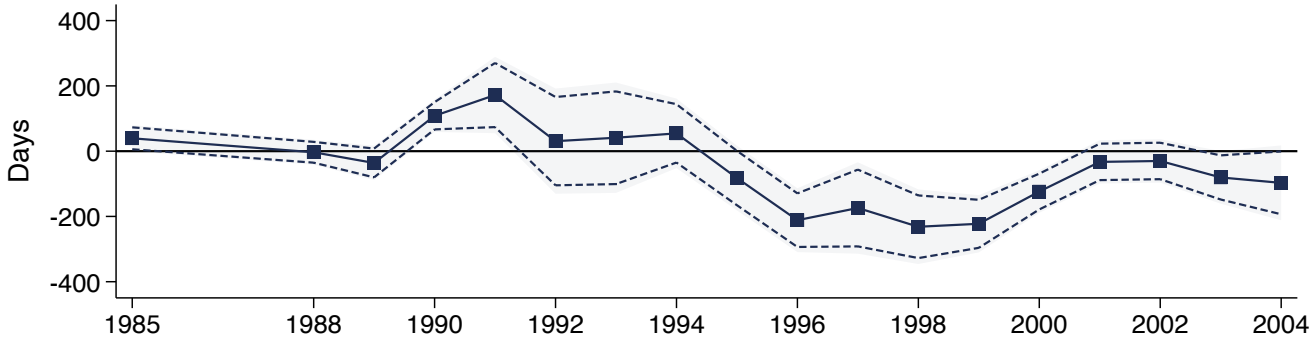
Triple-Difference Specification

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

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

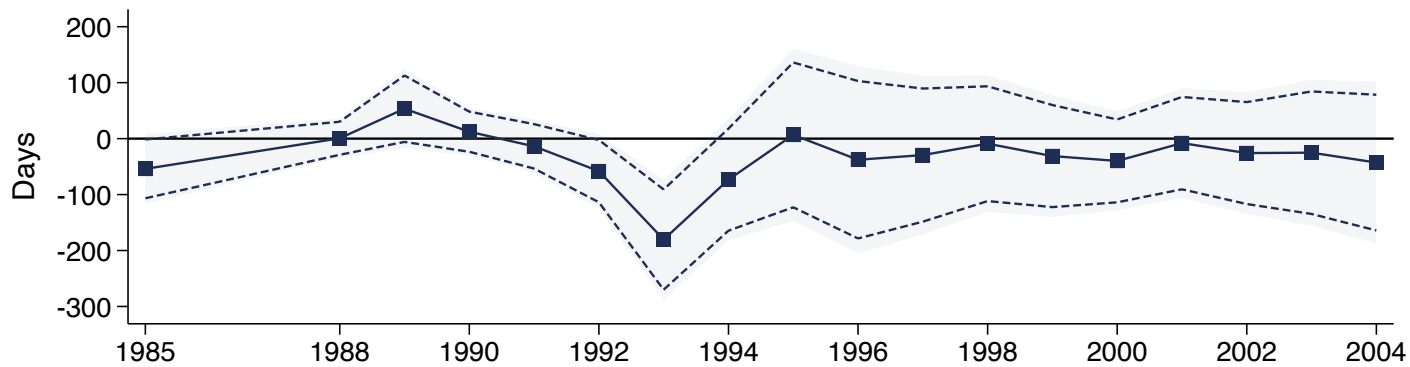
employment robustness

Direct Effect of Market Exposure

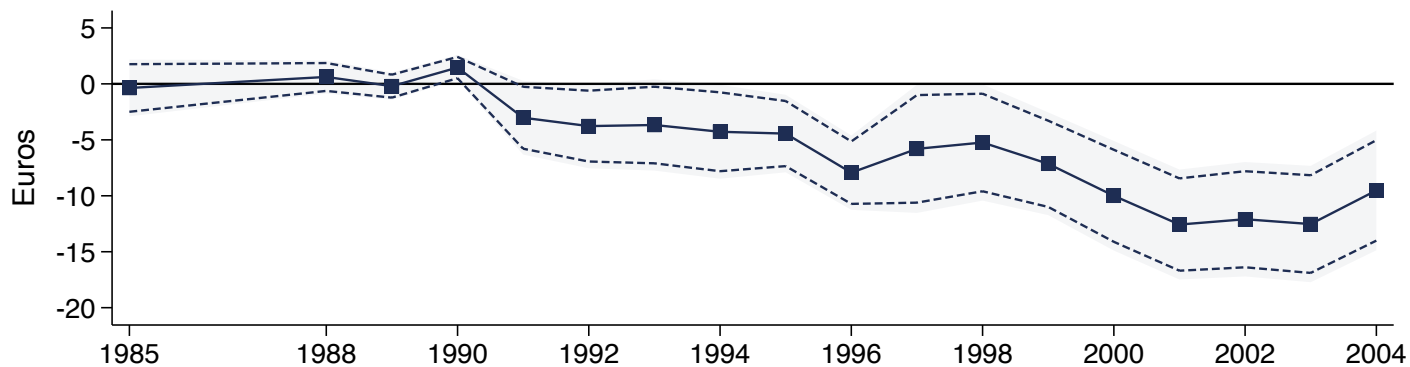
Double-Difference Specification (Drop Municipality Dummies in Controls$_i$)

$$\Delta n_{it} = \beta_t S_m + \text{Controls}_i'\zeta_t + \varepsilon_{it} \quad \text{and} \quad \Delta w_{it} = \beta_t S_m + \text{Controls}_i'\zeta_t + \varepsilon_{it}$$

Direct effect of market exposure (S_m) on employment



Direct effect of market exposure (S_m) on hourly wage



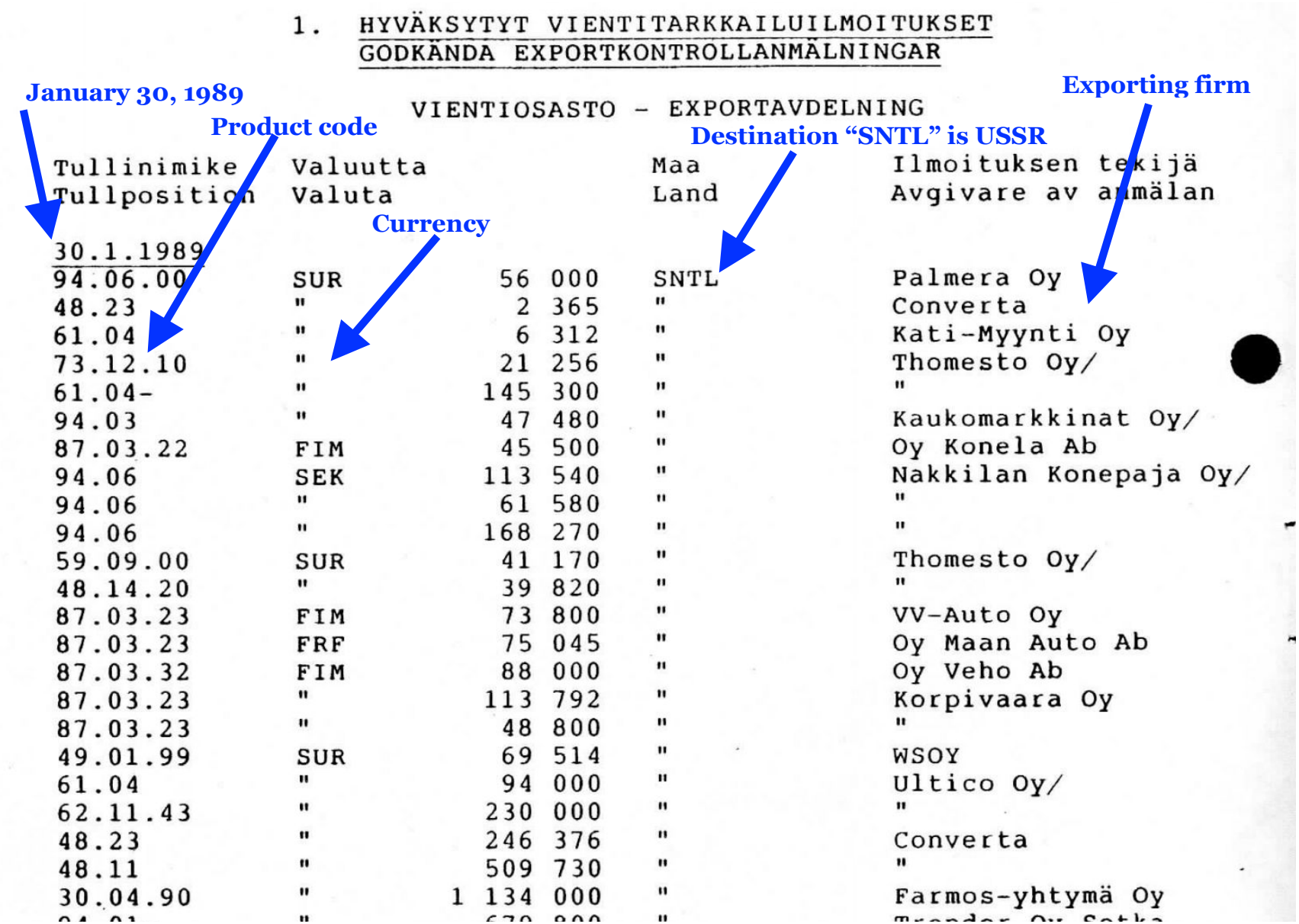
- **In line with Proposition 1:** Wages drop more in the long-run than short-run. Employment drops more in short-run than long-run.

Concluding Remarks

- How do local labor markets shape the response to trade shocks?
  - ~~Hypothesis #1: Workers exposed to negative trade shocks fair 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



1. HYVÄKSYTYT VIENTITARKKAILUILMOITUKSET
GODKÄNDA EXPORTKONTROLLANMÄLNINGAR

VIENTIOSASTO - EXPORTAVDELNING

January 30, 1989

Product code

Currency

Destination "SNTL" is USSR

Exporting firm

Tullinimike Tullposition	Valuutta Valuta		Maa Land	Ilmoituksen tekijä Avgivare av anmälan
30.1.1989				
94.06.00	SUR	56 000	SNTL	Palmera Oy
48.23	"	2 365	"	Converta
61.04	"	6 312	"	Kati-Myynti Oy
73.12.10	"	21 256	"	Thomesto Oy/
61.04-	"	145 300	"	"
94.03	"	47 480	"	Kaukomarkkinat Oy/
87.03.22	FIM	45 500	"	Oy Konela Ab
94.06	SEK	113 540	"	Nakkilan Konepaja Oy/
94.06	"	61 580	"	"
94.06	"	168 270	"	"
59.09.00	SUR	41 170	"	Thomesto Oy/
48.14.20	"	39 820	"	"
87.03.23	FIM	73 800	"	VV-Auto Oy
87.03.23	FRF	75 045	"	Oy Maan Auto Ab
87.03.32	FIM	88 000	"	Oy Veho Ab
87.03.23	"	113 792	"	Korpivaara Oy
87.03.23	"	48 800	"	"
49.01.99	SUR	69 514	"	WSOY
61.04	"	94 000	"	Ultico Oy/
62.11.43	"	230 000	"	"
48.23	"	246 376	"	Converta
48.11	"	509 730	"	"
30.04.90	"	1 134 000	"	Farmos-yhtymä Oy

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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

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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

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LDPM Plants by USSR Export Intensity, 1989

		By share of gross output exported to the USSR in 1989			
	All	0%	0–10%	10–50%	50–100%
A: Plant characteristics					
Gross output	8,207	4,991	33,860	38,277	15,615
Value-added	2,770	1,725	11,140	11,906	6,013
Number of workers	58.9	38.3	221.8	245.7	144.0
Value-added per worker	44.0	42.2	58.5	45.7	41.0
Capital / labor ratio	60.3	59.2	70.5	57.1	41.5
Plant age	10.5	10.2	12.9	12.6	12.5
Multi-plant firm	0.31	0.25	0.82	0.67	0.58
Share of output exported to the USSR	0.01	0.00	0.02	0.24	0.82
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).

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Worker Characteristics by Worker Exposure

	Manufacturing					Other
		By worker-level exposure				
	All	0%	0–10%	10–50%	50–100%	industries
A: Demographics						
Female	0.28	0.29	0.25	0.28	0.31	0.47
Age	35.4	35.2	35.9	35.8	35.7	35.4
First language Finnish	0.96	0.95	0.97	0.96	0.97	0.94
C: Level of education						
Less than secondary / unknown	0.33	0.33	0.32	0.30	0.23	0.27
Secondary	0.44	0.44	0.43	0.45	0.44	0.35
Advanced vocational	0.15	0.15	0.14	0.14	0.17	0.22
College	0.09	0.08	0.10	0.11	0.16	0.16
D: Field of education						
Technical	0.50	0.48	0.53	0.55	0.62	0.25
Other	0.16	0.17	0.14	0.14	0.15	0.45
Unknown	0.33	0.33	0.32	0.30	0.23	0.27
E: Earnings						
Annual earnings						

Notes: This table reports how characteristics of workers vary with their exposure to the USSR shock.

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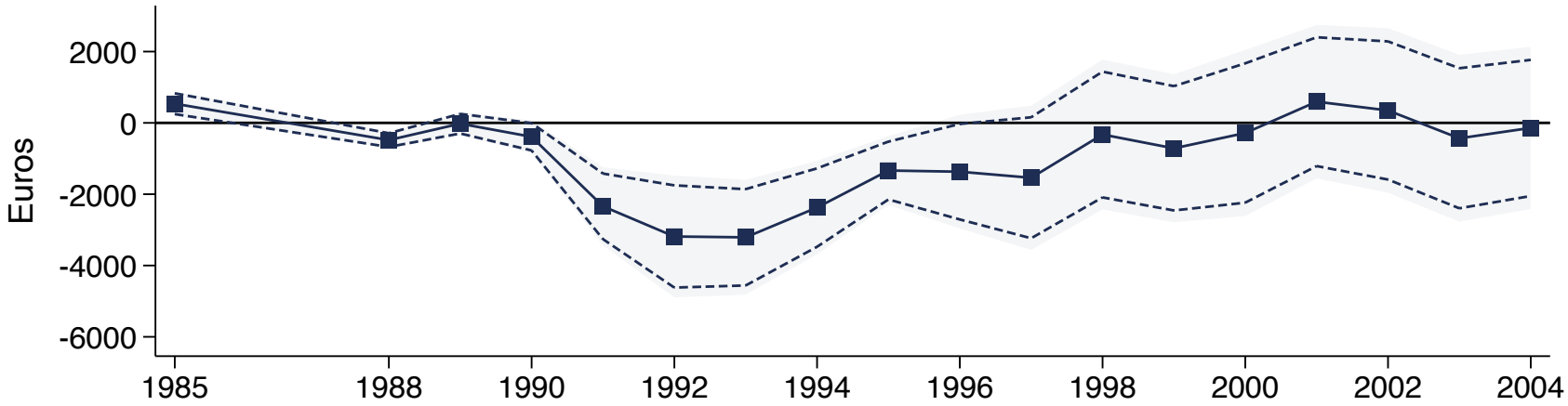
Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Baseline)

Direct effect of worker exposure (s_i)



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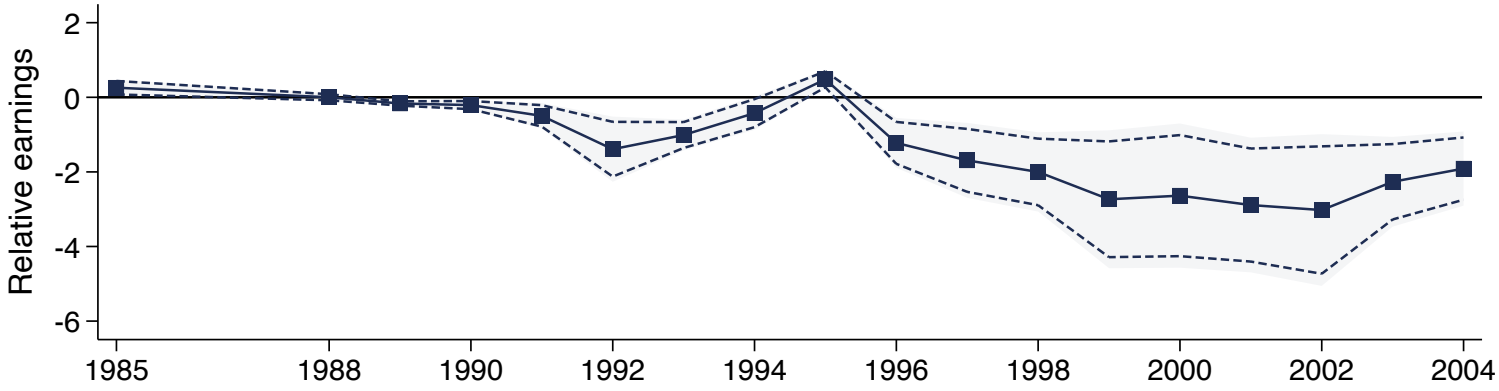
Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Relative Earnings)

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



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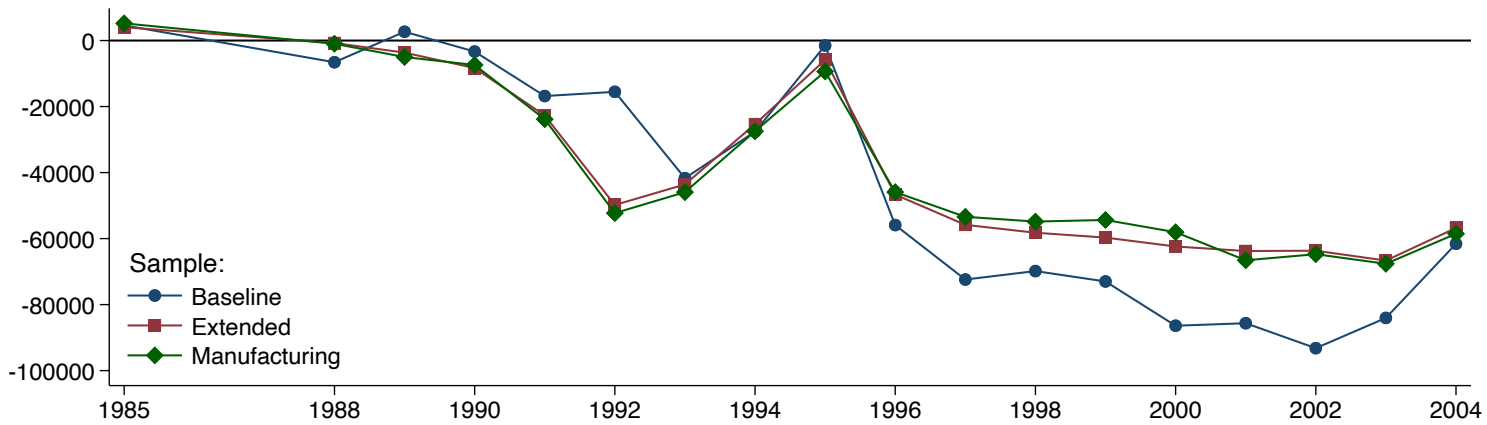
Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Alternative Worker Samples)

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



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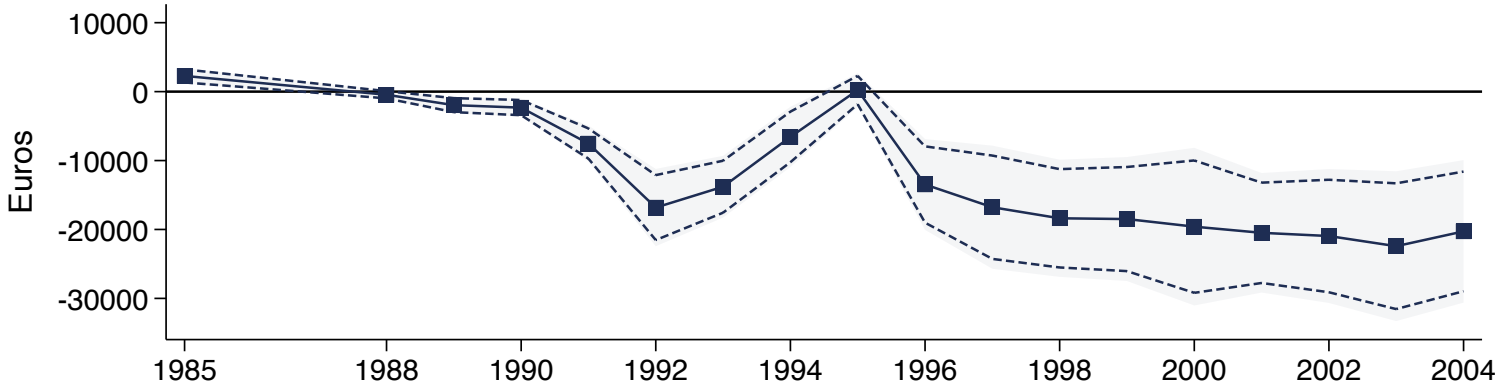
Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Measuring Exposure on Attached Sample)

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



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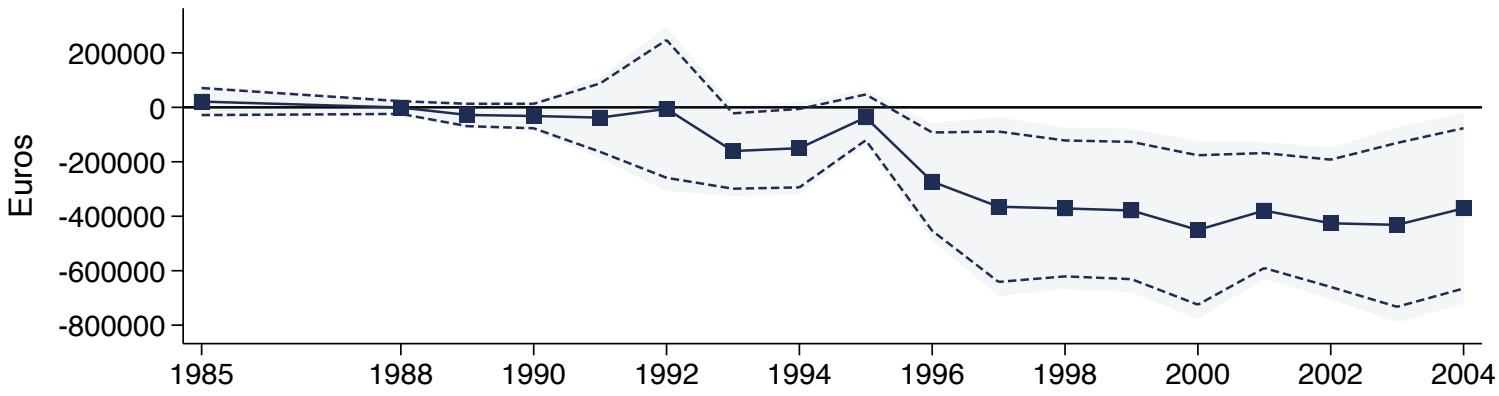
Exposure(s) to Trade and Earnings Dynamics

Triple-Difference Specification (Winsorizing Market Exposure)

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



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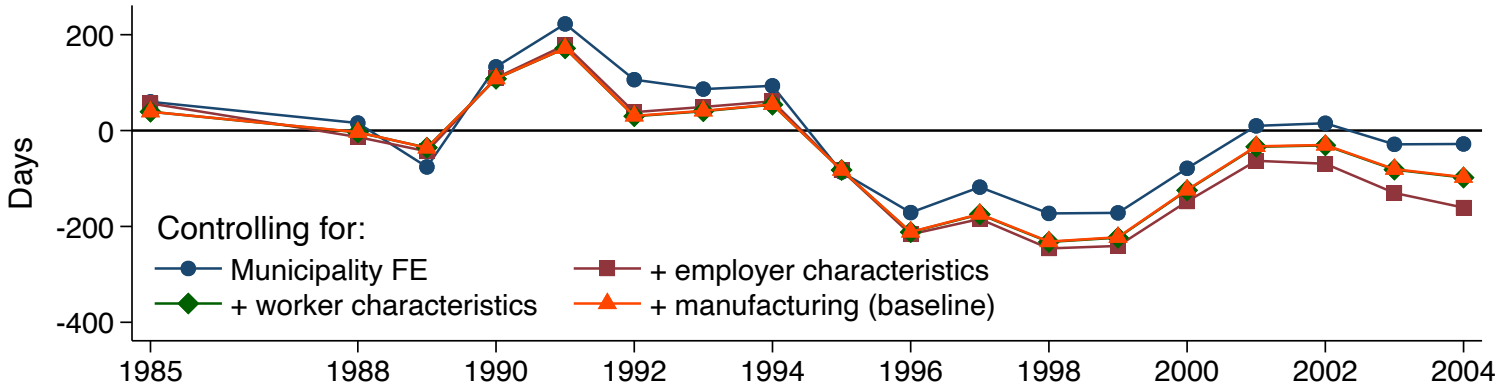
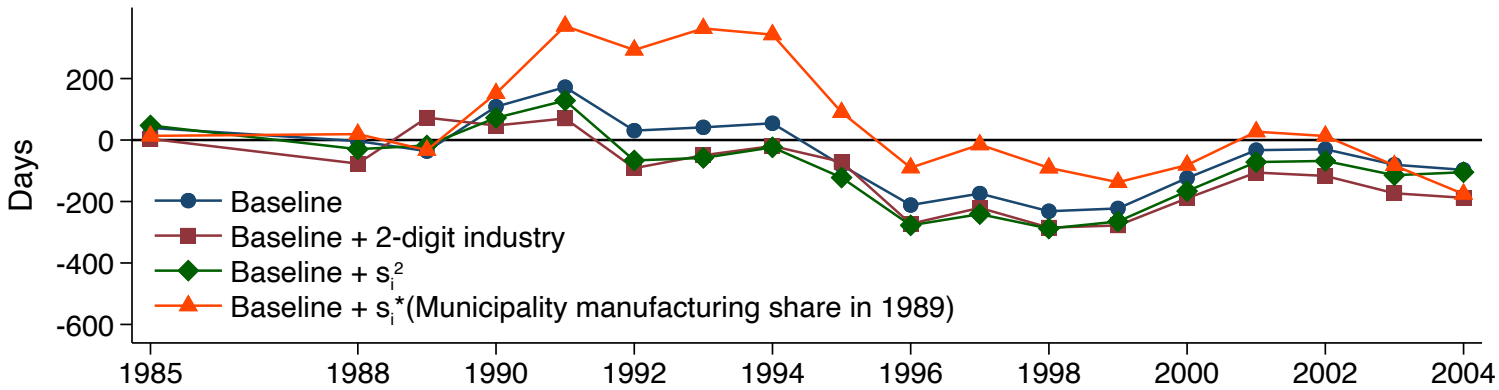
Exposure(s) to Trade and Employment Dynamics

Triple-Difference Specification (Alternative Worker Controls)

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



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



Job-finding rate derivation

- In discrete time, probability unemployed worker at t is employed at $t + \Delta$:

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

- As Δ goes to zero (and omitting the max...)

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

  which gives

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

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