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Population Responses to Local Labor Demand Shifts: Evidence from the Collapse of Finnish-Soviet Trade

Master's Thesis
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Abstract of master's thesis

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Abstract

I study how regional populations respond to local labor demand shifts by quantifying how the collapse of Finnish-Soviet trade in early 1990s affected regional working-age populations in Finland. I identify local labor demand shifts by using regional variation in the production of goods that were exported from Finland to Soviet Union. I find that the more local employment focused on the production of Soviet exported goods, the more region's share of total working-age population decreased in response to the shock. The demand shifts affected regions' demographic compositions as the reductions were driven by young and more educated people. The findings suggest that regional population responses contribute to equilibrating local labor markets after asymmetric labor demand shocks.

Keywords economics, local labor markets, population adjustment, Finnish-Soviet trade, spatial equilibrium theory

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Tutkin, miten paikallisen työvoiman kysynnän muutokset vaikuttavat alueelliseen väestökehitykseen. Lähestyn kysymystä arvioimalla, miten Neuvostoliiton kaupan romahtaminen 1990-luvun alussa vaikutti työikäisen väestön määrään eri alueilla Suomessa. Hyödynnän Suomesta Neuvostoliittoon vietyjen tuotteiden valmistuksen alueellista jakautumista arvioidessani paikallisen työvoiman kysynnän muutosten suuruutta. Tulokseni osoittavat, että mitä suurempi osuus alueen työpaikoista keskittyi Neuvostoliittoon vietyjen tuotteiden valmistukseen, sitä enemmän alueen työikäinen väestö supistui suhteessa muihin alueisiin viennin romahduksen seurauksena. Tulosten perusteella viennin romahdus vaikutti myös alueiden väestörakenteisiin, sillä nuoret ja korkeakoulutetut reagoivat muita väestöryhmiä herkemmin alueellisen työvoiman kysynnän muutoksiin. Tulokset viittaavat siihen, että muuttoliike osaltaan edistää alueellisten työmarkkinoiden sopeutumista epäsymmetrisiin työvoiman kysynnän muutoksiin.

Avainsanat taloustiede, paikalliset työmarkkinat, väestökehitys, Suomen ja Neuvostoliiton kauppa, alueellisen tasapainon teoria

Contents

1 Introduction

A well-functioning labor market provides labor for firms and employment opportunities for people. When labor demand contracts asymmetrically across regions, people in worse off areas can either accept less employment opportunities or move elsewhere. The more often people self-select to move in order to improve their situation, the more demand shocks' negative effects are ultimately mitigated through regional mobility.

I study how the mobility mechanism functions by examining how regional populations respond to relative changes in local labor demand. I identify regional demand shifts by using the unanticipated collapse of Finnish exports to Soviet Union in early 1990s. First, I quantify how exposed Finnish commuting zones (CZs) were to production of Soviet exported goods prior the collapse, identifying the magnitude of local demand shifts. Secondly, I examine how these demand shifts affected regional working-age populations after the trade collapsed.

The measurement of regional demand shifts is based on (1.) the scale of Soviet exported goods production in manufacturing plants that were located in the given region, and (2.) the share of the region's workers that were employed in these plants. Consequently, the variation in demand shocks' magnitudes arises from regional differences in local manufacturing production structure and its labor intensity. The range of exposure to Soviet exports production across Finnish CZs extended from 0.0 up to 11.2 percent.

I find that the more local employment focused on the production of goods that were exported from Finland to Soviet Union, the more region's population share decreased in response to the shock. Between 1989 and 1992, a one percentage point increase in region's dependency to Soviet exports translated into a 0.5 percent relative reduction in the region's working-age population. The estimate magnitude measures how region's working-age population changed in relation to other regions' population changes. The estimate is larger than absolute change as when people moved within the country, a reduction in one region's population simultaneously increased the population of others.

The export collapse had an impact on regional demographic compositions. The results imply that younger people (16-34 year-olds) were more responsive to changes in local labor market conditions than other age-groups. Furthermore, people with tertiary degree were more likely to move than people with lower educational attainment. My findings suggest that regional mobility increased with education and decreased with age.

Acknowledging that trade shocks potentially transmit to regional labor markets through supply-chain linkages, I identify plants that produced inputs used by manufacturers of Soviet exported goods. In addition, I identify plants that used Soviet export manufacturers' outputs in their production process. Identifying these plants allows me to decompose the shock into direct and indirect components. I use a similar identification strategy as in calculating direct export exposure metrics in measuring regions' upstream (input suppliers) and downstream (output buyers) exposures to Soviet export production. I find that regional upstream exposure predicted small relative population decreases shortly after the shock. Conversely, downstream dependency was associated with regional population increases.

In order to make causal interpretations of the results, it is critical that the Soviet exposure metrics are not, subject to controls, associated with factors that were driving regional population changes in early 1990s. To validate the conditional independence assumption, I take into account a rich set of region-specific characteristics that could have potentially driven changes in working-age populations. In addition, I run a falsification exercise, which shows that the direct Soviet exposure metrics did not predict population shifts shortly before the trade collapsed. However, both upstream and downstream dependencies predicted regional population changes already before the collapse. Therefore, the correlation between population shifts in early 1990s and upstream and downstream exposure metrics are not interpreted as causal effects.

The study is relevant for understanding the role of population changes in equilibrating local local markets after asymmetric shocks. In a spatial equilibrium setting, differences in local labor market conditions are equilibrated by local prices, amenities, individual preferences and regional populations. Interpreting the results through this framework, the findings suggest that changes in local prices and amenities were not enough to even out the shock's asymmetric welfare effects as people moved in response to the shocks. Furthermore, because the effects varied across demographic groups, the framework suggest that the groups were either varyingly attached to their home region or faced different economic incentives due to the shocks.

Earlier evidence on population shifts and economic shocks is inconclusive. My findings are consistent with Blanchard and Katz (1992) who find that labor migration was an equilibrating mechanism after asymmetric local demand shocks in the US during 1950-1990. The responses across demographic groups are in line with Bound and Holzer (2000) who find that in the US in the 1980s, college educated and young people were more responsive to demand shifts than other demographic groups. However, the results are not consistent with the evidence of Autor et al. (2013) who find that the rising Chinese import competition did not have regional population effects in the US. In line with Autoer et al. (2013), Dix-Carneiro and Kovak (2015) find that Brazilian trade liberalization in early 1990s did not have regional population effects.

My empirical strategy is closely related to trade literature that uses quasi-natural experiments in identifying regional labor market shocks. I construct exposure metrics that take into account both manufacturing production and employment information in calculating local labor market dependencies, similarly to Autor et al. (2013) and Topalova (2010). In addition, the study contributes to recent work that empirically estimates the role of supply-chain linkages for employment outcomes, for instance Acemoglu et al. (2016) and Pierce and Schott (2016). The thesis complements the literature by offering views how supply-chain linkages relate to local population changes after demand shocks.

The remainder of the thesis is organized as follows. In section 2, I describe the collapse of the Finnish Soviet trade and argue that the shock was unanticipated and externally driven. In section 3, I review relevant empirical literature that examines the relationship between trade shocks, labor market conditions and population shifts. In section 4, to motivate the empirical analysis, I present a theoretical framework that formally establishes the links between product demand shocks caused by Soviet export collapse and regional populations. Section 5 includes a description of the empirical strategy, data sources and details on measurement. Section 6 provides the OLS estimates between the Soviet export exposure metrics and regional populations. Furthermore, the section includes a discussion on the results, their limitations and robustness. Section 7 concludes.

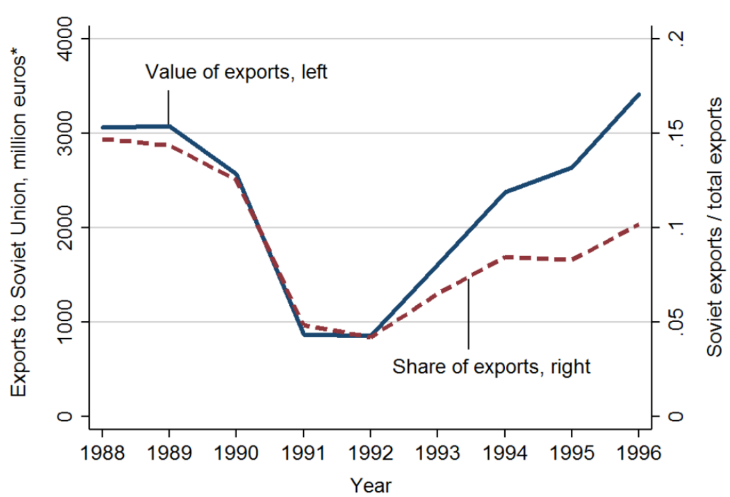
2 The collapse of Finnish-Soviet trade

The collapse of Finland's exports to Soviet Union was put in motion by USSR's internal political processes in late 1980s and early 1990s. USSR started to adopt several political reforms, so called perestroika, that embedded market mechanisms in the planned economy system.

Bilateral contracts in late 1980s indicated that business was to continue as usual in early 1990s. In October 1989, Finland and Soviet Union agreed on the terms of bilateral trade for years 1991-1995 but in December 1990, USSR cancelled these contracts and announced the demise of the bilateral clearing system[1] (see Laurila, 1995, for timeline). This marked USSR's transition towards decentralized convertible currency trade.

The changes in USSR's trade policies were not widely anticipated in Finland. Matala (2011) examines the records of intra-governmental Finnish-Soviet trade commission and finds that the information on clearing trade's demise was held within a closed network. The commission allowed Finnish businesses to negotiations no earlier than the year 1990. Convertible currency trade began in January 1991 and the value of exports plummeted during the following two years.

Figure 1: Value and share of Finland's exports to Soviet Union, 1988-1996



Data source: OECD ICTS (HS88), Statistics Finland. Soviet Union is defined in geographic terms from 1991 onwards. The data includes Soviet Union for years 1988-1990, for 1991, Soviet Union, Estonia, Lithuania and Latvia, for 1992 onward Russia, Estonia, Lithuania, Latvia, Armenia, Azerbaijan, Belarus, Uzbekistan, Tajikistan, Turkmenistan, Kyrgyzstan, Kazakhstan and Ukraine. Values are converted to current euros using ICTS exchange rates and to 2000 prices using export price index.

[1] The function of Soviet-Finnish clearing system was to clear payments on exports and imports without monetary transactions.

Figure 1 shows that two thirds of Soviet export value disappeared between 1989 and 1991. At the same time, the share of Soviet exports dropped from 15 percent to less than 5 percent.

Sutela (1992) underlines that the trade collapse was a consequence of abolishment of political decisions that had earlier given Finland a priority in Soviet Union's foreign trade compared to other Western countries. USSR had limited market access to other Western trade partner, which is why Finland exported goods to Soviet Union that were not extensively exported to other countries, for instance textiles and footwear (Sutela, 1992).

Table 1 shows that the structure of Soviet exports differed significantly from the structure of Finnish manufacturing production and several industries were heavily reliant on Soviet exports.

Table 1: The share of different product categories in Soviet exports and Finnish manufacturing production in 1988

Product category	Export share, ↓ (1)	Manuf. share (2)
Ships, boats and other floating structures	20.45 %	1.56 %
Paper, paperboard, articles of pulp	19.03 %	12.72 %
Nuclear reactors, boilers, machinery	15.19 %	8.73 %
Electronic equipment	8.78 %	4.72 %
Railway, tramway locomotives	4.48 %	0.38 %
Apparel, accessories, not knit or crochet	3.68 %	1.15 %
Plastics and articles thereof	3.07 %	2.89 %
Pulp of wood, cellulosic material, waste etc.	2.89 %	4.52 %
Footwear, gaiters and the like, parts thereof	2.73 %	0.50 %
Articles of iron or steel	2.45 %	3.20 %
Apparel, accessories, knit or crochet	1.90 %	0.53 %

Sources: Statistics Finland, OECD. Categories are listed at 2-digit commodity levels.

Column 1 in table 1 shows that ships, paper and nuclear reactors were among the largest single product categories in Finland's exports to Soviet Union in 1988. By comparing the export shares in column 1 and manufacturing shares in column 2, it is evident that ships, boats, railway equipment, footwear and apparel were overrepresented in Soviet exports compared to their share of domestic manufacturing production. Ships and boats constituted more than fifth of Soviet exports but around two percent of total manufacturing production.

Other product categories that were overrepresented in Soviet exports were footwear, railway equipment and apparel that constituted more than nine percent of exports but only two percent of manufacturing production. These industries were particularly sensitive to changes in Soviet exports.

Several factors distinguished Soviet exports from other Finnish trade. Firstly, Soviet exported goods were sold at a premium compared to other trade. Kajaste (1992) identifies export items that enjoyed a price premium of around ten percent. Gorodnichenko et al. (2012) find even higher price premiums for exported goods. These price-differentials suggest that even in the presence of replacing markets, Soviet exporters would suffer from the collapse as the prices would fall from earlier anomalic levels. Secondly, the goods that were imported from Finland had to be to a high degree of Finnish origin (Kajaste, 1992), suggesting that input producers were also vulnerable to shifts in Soviet exports.

Soviet Union traditionally paid for Finnish exports with energy imports through the clearing account. Consequently, the bilateral system's demise resulted in major drops in Finnish imports from Soviet Union. Crude oil, petroleum oil and petroleum gas constituted around 70 percent of all imports from Soviet Union before the collapse. Between 1990 and 1993, the value of imports from Soviet Union fell by one third. In 1990, 94 percent of the Finnish crude oil imports came from Soviet Union but the share plummeted to 14 percent in 1992 (Rautava, 1994).

Labor market institutions are central in determining how different shocks are transmitted to the economy. In Finland, wage decisions were negotiated through a collective wage bargaining system. Nominal wages rose in 1990 and 1991 but were held at 1991 level in 1992-1994 in a centralized wage agreement between labor market organizations (Kiander and Vartia, 1998). Due to nominally rigid wages, firms could not adjust to product demand changes at the wage margin. Consequently, employment reductions were common during the depression as firms laid off employees due to production-related reasons.

In early 1990s, the national employment rate dropped from 55 percent to 45 percent in three years. The declines were unevenly distributed across regions and some CZs experienced approximately 15 percentage point drops in employment rates while others survived with minor reductions.

3 Literature review

In this section, I review empirical literature that examines how economic shocks affect regional populations or local labor market conditions. In addition, I describe how the empirical methodology progresses from descriptive evidence towards experimental and instrumental designs that aim to capture causal evidence. Furthermore, I review other recent empirical approaches that offer complementary views on the topic.

Early empirical evidence focuses on descriptive associations between local conditions and population changes. Pissarides and Wadsworth (1989) investigate, using standard regression methodology, how unemployment predicted inter-regional migration in Britain in 1970s and 1980s. They find that households with unemployed heads were more likely to move compared to households with employed heads. They do not find significant results that regional unemployment differentials would have driven migration patterns. Furthermore, they quantify moving probabilities and find that young and more educated were more likely to move.

A structural approach by Blanchard and Katz (1992) takes steps further and attempts to identify causality between local labor market conditions and labor market outcomes. Blanchard and Katz examine how negative shocks to employment affected unemployment and wages in the US in 1947-1990 using a vector autoregressions model (VAR). They analyze the joint movement of regional variables taking into account state fixed effects and find that negative shocks affected regional unemployment and employment rates. The effects on unemployment rates disappeared between five to seven years due to out-migration of workers. Authors find that regional migration was more responsive to changes in employment than to changes in relative wages. They conclude that labor mobility was the most important channel for local labor market adjustment, exceeding job-creation and job-migration in importance.

Another empirical approach uses exogenous variation in local demand conditions in attempting to find causal evidence. Bartik (1991) develops a local labor demand instrument, which is based on national industry employment changes that are weighted to regions based on their industry employment shares. Using this method, Bartik (1991) finds that between 1972-1986, local demand shocks caused regional out-migration in the US.

Later empirical literature expanded the scope of measuring variation in local demand conditions. Blanchard and Katz (1992) use military expenditure as an instrument to identify variation in regional demand and find results that are consistent with their findings using the VAR-approach. Bound and Holzer (2000) estimate demand effects by quantifying national changes in total hours worked in different industries and use local industry employment shares to weigh changes to regions. They find that during the 1980s in the US, regional populations adjusted to local demand shifts. In consistence with Pissarides and Wadsworth (1989), they find that younger and more educated were more likely to move due to demand changes.

Bartik-type demand instruments assume, through the exclusion restriction, that national industry employment shifts are not correlated with local labor supply changes. It is possible, however, that various regional labor supply shifts have national industry employment effects. Furthermore, it is difficult to test the assumption's validity because local labor supply and national employment change simultaneously.

Quasi-natural experiments resemble random assignment, which is why they offer plausible exogenous variation to study local labor market outcomes. Topalova (2010) analyzes how the 1991 Indian trade liberalization affected regional poverty in Indian districts by using industry-specific tariff-changes, which are weighted to regional level using regions' initial manufacturing structure. Topalova underlines that the tariff changes were sudden and externally placed. Therefore, the changes should not be related to trends in regional poverty. Following a similar identification strategy, Dix-Carneiro and Kovak (2015) quantify the impacts of Brazilian 1990s trade-liberalization on local labor market outcomes and find that Brazilian regional trade shocks had employment and wage effects but were not associated with regional migration.

Another way to validate exogenous variation in local conditions is using more plausible instrumental variable designs. Autor et al. (2013) study how regional exposure to growing Chinese import competition affected local labor market outcomes in the US. Instead of using domestic imports from China to identify local supply shocks, they instrument China's growing influence in international trade by Chinese imports to other developed economies. This plausibly mitigates the issue on endogenous domestic industry imports. The identifying assumption is that the demand of other developed countries is not correlated with the US industry demand. They quantify regional exposure by calculating changes in Chinese imports for each industry and weighting the effects regionally by using regional industry employment shares. They find that the rising imports over 1990-2007 contributed substantially to the aggregate decline in US manufacturing employment. Authors find that the shock did not have impacts on regional populations.

One strand of empirical literature looks at the effects of demand shocks in general equilibrium. This allows to take a more comprehensive view on effects but requires additional assumptions. Diamond (2016) estimates demand shifts and other general equilibrium effects by using a structural equilibrium approach. Along with the local labor demand component, the model takes into account various local supply components, including housing, amenities and labor. Diamond finds that local labor demand matters for migration patterns. In particular, local labor demand was an important determinant for college graduate migration patterns between 1980 and 2000 in the US. Another important finding is that the concentration of college graduates made cities more attractive to them, implying that amenities were endogenous of earlier migration patterns.

Mobility costs are central for labor mobility. Engelhardt (2002) finds that housing prices add to moving costs as people avoid monetary losses and are therefore not willing sell a house in a declining area. The results suggest that housing prices incentivize residents of declining regions to stay. Empirical migration literature offers evidence on people's behavior in the presence of high moving costs. Kennan and Walker (2011) develop a structural econometric model of migration where moving decisions are made to maximize the expected value of lifetime income. In their model, different locations have known wage distributions and amenity values. Their findings imply that income prospects substantially influence migration decisions and weak income prospects in current location increase the probability of out-migration. Results hold even if substantial moving cost and regional attachment exist.

Recent empirical work pursues to decompose the population shifts into components. Foote et al. (2015) identify local demand shocks by using variation arising from mass layoff events in the US after 2008. They study what were the main channels behind local labor force changes, including out-migration, in-migration, retirement and disability insurance. They find that the layoffs decreased regional labor force and a a large share of the decrease was driven by out-migration.

Theoretical literature shows that supply-buyer relationships amplify economic shocks (e.g. Acemoglu et al., 2012). Reflecting this finding, Pierce and Schott (2016) use plant-level information on input-output linkages in the US and quantify how tariff-changes on Chinese imports affected employment in the US. They find that the linkages had negative effects on plant employment. Acemoglu et al. (2016) apply similar approach by calculating how Chinese import competition affected industries through supply-chain linkages in the US. They find that indirect links contributed significantly to negative employment outcomes in industries. In particular, upstream industries that were selling intermediate products to directly affected industries contributed to negative employment effects.

4 Theoretical motivation

In this section, I provide a theoretical framework to build intuition on the mechanisms between regional mobility and the Soviet export collapse. The section is divided into two. First, I describe how local employment was potentially affected by adverse shocks to local product demand. Secondly, I show how shifts in employment create pressure for local population responses.

A. The effects of Soviet trade collapse on regional employment

The export collapse reduced the demand for goods that were exported to Soviet Union and manufacturers that produced the goods experienced a negative demand shock for their outputs. The shock's magnitude to an individual plant depended on the export share of its outputs. Furthermore, the plants' output elasticity of labor contributed to the magnitude of employment effects (see appendix A.1. for formal derivation). Regionally, the negative employment effect depended on how many plants were located in a given region.

The adverse product shocks had indirect effects on plants that were connected to Soviet export manufacturers through input-output linkages. These linkages were relevant for both the Soviet export manufacturers' input-suppliers (upstream plants) and output-buyers (downstream plants).

For upstream plants, the shock negatively shifted the demand for outputs that were used as inputs in Soviet export manufacturers' production process. The magnitude of these effects depended on the output elasticity of the inputs that were used in the Soviet export manufacturers' production process. Secondly, the magnitude to local employment depended on upstream plants' output elasticity of labor (see appendix A.2. for formal derivation).

The indirect effects on downstream plants were less clear. The shock reduced the demand for Soviet exported goods, which translated into a positive supply shock to plants that used these goods as inputs. This supply shock potentially caused price reductions. However, in the longer term, the drops in prices lowered the profitability of Soviet export manufacturers and potentially caused shutdowns of plants. Shutdowns would negatively affect output supply and increase the price of inputs for downstream plants. Therefore, the collapse in exports was followed by both upward and downward price pressure for downstream exposed plants. Therefore, the shock's effect on employment through downstream-linkages cannot be unambiguously determined.

Acknowledging that wages were nominally rigid in Finland in early 1990s, firms could not adjust to changes in demand conditions through wage changes. Therefore, firms were pressured to adjust at the employment margin, lowering employment in regions with exposed plants.

B. Population responses to asymmetric employment changes

I show that the shifts in local employment increase pressure for local labor supply responses by following a spatial equilibrium model. The mechanism behind spatial equilibrium is wealth maximization hypothesis, which states that people and firms self-select their location by comparing which region offers highest level of utility (formalized in Roback, 1982). The rationale translates into regional equilibrium through aggregation of individual decisions. Spatial equilibrium is obtained when marginal firms and individuals are indifferent between locations and nobody benefits from moving.

I follow a model by Moretti (2011) in which regional populations, local wages, amenities, cost of living and individual preferences equilibrate the quality of living between regions. I complement the setting by including region-specific unemployment, which affects people's utility through the risk of unemployment, a mechanism acknowledged for instance in Harris and Todaro (1970). I focus solely on the consumer side of spatial equilibrium, ignoring potential firm relocation.

Utility for employed individual i for living in region a is the sum of local nominal wage w_a, cost of living r_a, amenities A_a and individual preferences for the region, e_{ia}:

$$U_{ia} = w_a - r_a + A_a + e_{ia}, \tag{1}$$

Unemployed individual k makes comparisons between regions based on expected regional wages $\tilde{w_a}$, instead of nominal wages:

$$U_{ka} = \tilde{w_a} - r_a + A_a + e_{ka}, \quad \text{where} \quad \tilde{w_a} \equiv \frac{L_a}{N_a} w_a, \tag{2}$$

where L_a is the number of employees and N_a is the total number of working-age population in the region. Local employment situation affects individual utility because it affects the likelihood of obtaining a job.

Between two regions, individual k chooses location a instead of b when her relative preferences for the region exceed economic and amenity differences:

$$e_{ka} - e_{kb} > (\tilde{w}_b - r_b) - (\tilde{w}_a - r_a) + (A_b - A_a) \tag{3}$$

where $e_{ka} - e_{kb}$ measures individual's relative preference for living in region a. Location choice reflects differences in individual preferences, expected regional wages, cost of living and amenity values. In spatial equilibrium, a marginal worker is indifferent between the regions. Static equilibrium for local labor supply for region a is:

$$\tilde{w}_a - \tilde{w}_b = (r_a - r_b) + (A_b - A_a) + s\,\frac{N_a - N_b}{N}, \tag{4}$$

where parameter s captures the relative preference of labor for region a, N_a is the number of working-age people in region a, and N is total number of people in regions a and b. The share of working-age people in regions equilibrate differences in expected wages, amenity values, costs of living and preferences.

If region a experiences a larger adverse demand shock than region b, the left hand side of equation 4 decreases. The equation shows that changes in relative local employment in region a must be matched by changes in relative local prices, amenities or population shares. The framework shows that population responses to demand shocks are ambiguous. If local prices are elastic and the negative shock lowers local prices, the pressure for regional population shift decreases. If regional amenities decrease in response to local demand shift (through closure of services, for instance), then the pressure for local population responses increases. If price shifts are insufficient to absorb local employment changes' effects on utility, the response in local population depends on regional attachment. Lower level of attachment implies higher population changes.

The discussed mechanism is based on people that were not employed. However, the spillover to employed people depends on how regional prices and amenities are affected by the demand shocks. If local prices decrease, the utility of living in the region further increases but a drop in amenities would have an opposite effect on utility for local workers.

The framework suggests that economic shocks to local labor markets have population responses only when certain conditions hold. First, local populations respond to demand shifts if people rationally seek to improve their welfare. Secondly, economic incentives, arising from the shock's relative magnitude, need to exceed the relative shifts in other region-specific characteristics and regional attachment. Acknowledging the ambigiuity of population responses sets the starting point to the empirical section, in which I empirically estimate how the mechanism between regional populations and changes in local labor market conditions functions.

5 Empirical approach

In this section, I present details on the empirical model, data and measurement of Soviet export exposure. The metrics that capture variation in demand conditions are divided into direct, upstream and downstream exposure.

5.1 Empirical strategy

The identification of demand shifts is based on quasi-natural experiment. I use the collapse of Finnish-Soviet trade as an experiment in order to identify plausible exogenous variation in local demand conditions. The identifying assumption is that these metrics are not correlated with any underlying population trends or any confounding factors that were associated with population changes in early 1990s, subject to controls.

Regional exposure is based on the plants that were located in each region:

(1) *Direct exposure*: Plants that manufactured goods that were exported to Soviet Union.

(2) *Upstream exposure*: Plants that produced commodities that were used as inputs in plants that manufactured Soviet exported goods.

(3) *Downstream exposure*: Plants that used inputs produced by plants that manufactured Soviet exported goods.

I use linear regression to estimate the relationship between regional population changes and regional Soviet export exposure metrics. The main specification of the empirical model decomposes the Soviet export collapse into direct and indirect components:

$$\Delta\tilde{P}_r = \alpha + \beta Direct_r + \delta UE_r + \gamma DE_r + X'_r + e_r, \tag{5}$$

where $\Delta\tilde{P}_r$ is the change in regional log-transformed working-age population[2], $Direct_r$ measures region's labor-market exposure to Soviet exported goods production, UL_r measures exposure through upstream linkages and DL_r through downstream linkages. X' is a vector of start-of-period regional characteristics.

In the main specifications, 1989 is defined as the pre-shock year, following the fact that

[2]Formally: $\Delta\tilde{P}_r = \log(P_1) - \log(P_0)$ where P_1 is regional working-age population after the shock and P_0 is regional working-age population before the shock. Using logarithms compresses variation and reduces the role of outliers.

the announcement on clearing system abolishment was made in 1990. All regressions are weighted by CZs' start-of-period populations in order to measure changes in number of people living in regions.

Control variables include regional industry structure, age structure and education structure (complete list of control variables is provided in Appendix B). In addition, to take into account the possibility that Soviet export dependency was correlated with Soviet import dependency, I construct a regional control variables for Soviet energy imports, following an identical identification strategy as with export metrics (details on measurement are included in Appendix C.). I use pre-shock-period controls to avoid the problem of over-controlling[3].

I use the 1993 division of CZs as the unit of analysis. CZ borders have a transparent definition that is based on access to jobs[4]. Therefore, regions identify local labor markets more plausibly than municipal borders, for example. The regions cover the whole mainland. One CZ, Maarianhamina, is omitted because it differs from other regions in several unobservable ways: it has separate legislation and it is geographically isolated from the mainland.

5.2 Data sources

I use three main data sources: Finnish Longitudinal Employer-Employee Data (FLEED) and Longitudinal Database on Plants in Finnish Manufacturing (LDPM), from Statistics Finland. I complement this with OECD's International Trade by Commodity Statistics (ITCS), which includes exports from Finland to Soviet Union. I use the year 1988 to calculate Soviet dependency for each region.

FLEED is a cross-sectional data, which includes all working-age individuals in Finland, approximately 3.6 million people for years 1988-1996. The data includes information on people's region of residence, which allows to quantify changes in regional populations[5]. In

[3]Over-controlling occurs when the control variables could itself be outcomes. In order to avoid this, I use before-shock variables as controls and after-shock changes as outcomes.

[4]A municipality is defined as a CZ, if it has at most 20 percent employees employed in another municipality. In addition, no more than 10 percent of its employees can be employed in another single municipality. Other municipalities are included in the commuting zone if more than 25 percent is employed in the central municipality.

[5]Defining the CZ borders requires matching time-varying municipal borders together. In FLEED, the information on individuals' place of residence is on municipality-level, which is based on the municipal division of 2012. I use 1993 CZ borders that are based on 1993 municipality division. In few situations, a municipality that existed in 1993 and belonged to a certain CZ merged with another municipality between

addition, the data includes individual level information on education, employment status and age. I use the information to form outcomes for different demographic groups and various control variables. Furthermore, the data includes individuals' employment information on plant level, which allows me to quantify how many workers worked in each plant and industry-shares for each region. Data is based on end of year information.

LDPM includes information on manufacturing firms' production on plant-level. The data includes both output and input information at 8-digit HS88 commodity classification. It includes all plants with at least five employees in the current year. Value data is in 1000 current markkas, which I convert to current euros using the fixed euro-markka exchange rate. The data is recorded when the goods are sold. I use LDPM's input-output data to calculate upstream and downstream exposures.

ITCS includes data on trade between Finland and Soviet Union. Data lists values of commodity export at 6-digit HS88 commodity classification. Because the Soviet exposure metrics are based on combining OECD and Statistics Finland data, all calculations are performed at 6-digit level. OECD data is listed in current dollars, which I convert to current euros using the ITCS export and import exchange rates.

5.3 Measurement of Soviet export exposure

I quantify Soviet export exposure for each CZ in Finland. In order to quantify regional direct exposure, I first calculate the share of domestic production for each commodity for each plant. Then, I use the plant-level shares to measure the role of each plant in the production of Soviet exported goods. These steps are similar to Einiö (2015) who uses plant-level production shares to identify demand shifts caused by the Soviet-export collapse. Next, I weight the production figures with the number of employees in each plant located in a given region in order to measure local labor market exposure. This step is analogous to Topalova (2010) and Autor et al. (2013) who use industry employment shares as weights to measure local shifts.

Using detailed commodity and plant-level data allows me to control for a rich set of regional characteristics. The exposure metrics are calculated from plant-level commodity production

1993 and 2012 that had a different CZ in 1993. In these cases, I define CZ borders so that the CZ for the merged municipality is based on its central municipality's CZ in 1993 division.

and trade data at the 6-digit level, which allows variation within regional exposure even though the structure of regions' manufacturing industry structure is controlled for.

5.3.1 Direct exposure

Direct exposure measures exposure to plants that produced commodities that were exported to Soviet Union before the collapse. Regional exposure arises from the share of production of exported commodities in plants that were located in the region and the share of region's workers that were employed in these plants.

Commodity exports are allocated to plants using their commodity production shares. Each plant's exposure to Soviet export production, ϕ_j, is quantified in the following way:

$$\phi_j = \left(\sum_c E_c \frac{Y_{jc}}{Y_c} \right) \frac{1}{Y_j}, \tag{6}$$

where E_c is the value of Soviet exports of commodity c, Y_{jc} is the value of plant j's production of commodity c, Y_c is total value of production of commodity c in Finland, Y_j is plant j's value of total production. Regional direct exposure, $Direct_r$, is calculated by weighting plant-level figures by plants' employment shares in the region:

$$Direct_r = \sum_{j \in I(r)} \phi_j \frac{L_j}{L_r}, \tag{7}$$

where L_j is the number of employees in plant j and L_r number of employees in the region, $I(r)$ is a set including all plants in region r.

Equations 6 and 7 show that region's exposure could reach 100 percent only if all plants located in the region produced commodities that were solely exported to Soviet market, so that $\phi_j = 1 \;\forall\; j \in I(r)$ and all workers were employed in these plants, $\sum_{j \in I(r)} L_j = L_r$.

5.3.2 Upstream exposure

Upstream metric measures local exposure to the production of directly exposed plants' inputs. The exposure is calculated using plant-level direct exposure figures to identify the extent of commodities' exposure to first-order upstream-linkages[6]. I assume that all directly

[6]I focus solely on first-order linkages when calculating indirect exposure metrics. Second order linkages refer to upstream exposed plants' upstream-linkages etc.

exposed manufacturers' inputs were exposed at the same rate as the plant's direct exposure. Following the assumption, upstream exposure for each commodity, UE_c, is calculated in the following way:

$$UE_c = \sum_j \phi_j \mu_{jc} \tag{8}$$

where ϕ_j is direct exposure for each plant (as calculated in the previous section), and μ_{jc} is the input-usage of plant j for commodity c. Regional upstream exposure, UE_r, is then:

$$UE_r = \sum_{i \in I(r)} \left(\frac{1}{Y_i} \sum_c Y_{ic} \frac{UE_c}{S_c} \right) \frac{L_i}{L_r}, \tag{9}$$

where Y_{ic} is value of production of commodity c in plant i. S_c is value of total supply of commodity c in Finland (sum of domestic production and imports), and Y_i is total production of plant i[7].

5.3.3 Downstream exposure

Downstream metric measures local exposure to directly exposed plants' outputs. Downstream exposure measures how much plants used directly exposed plants outputs in their production process. I assume that directly exposed plants' outputs were exposed at the same rate as the plant's exposure. Downstream exposure for each commodity, DE_c, is calculated in the following way:

$$DE_c = \sum_j \phi_j Y_{jc}, \tag{10}$$

where ϕ_j is direct exposure for each plant, and Y_{jc} is directly exposed plants' commodity production. Regional downstream export exposure (DE_r) is then:

$$DE_r = \sum_{i \in I(r)} \left(\frac{1}{\mu_i} \sum_c \mu_{ic} \frac{DE_c}{S_c} \right) \frac{L_i}{L_r}, \tag{11}$$

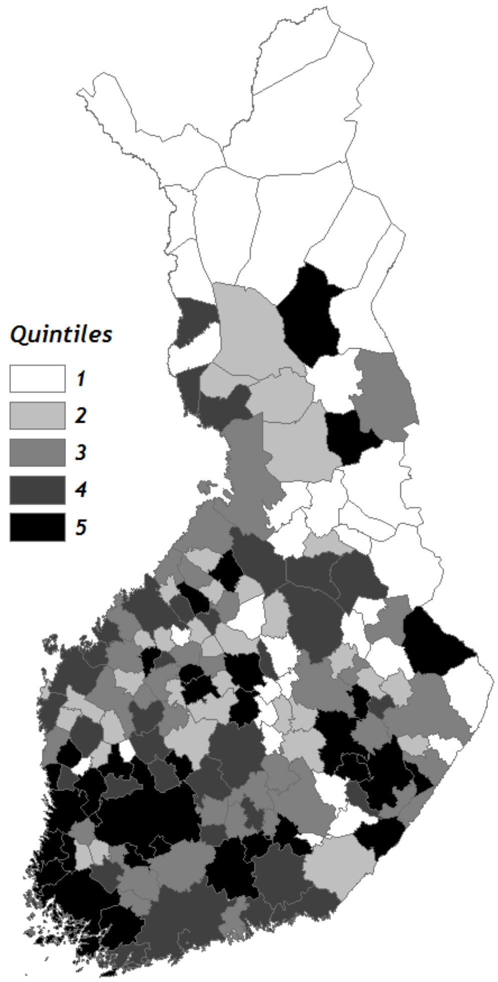
where μ_{ic} is the usage of commodity c in plant i's production process, S_c is the supply of commodity c in Finland (sum of domestic production and imports), and μ_i is the total input-use of plant i.

[7]Notation distinguishes between directly exposed plants, j, and indirectly exposed plants, i, but both i and j are drawn from the same set of plants.

5.4 Descriptive statistics

The range of regional variation in direct exposure extends from 0.0 percent to 11.2 percent.

Figure 2: Direct Soviet exposure quintiles in 1988, by CZs



Notes: Map source: National Land Survey of Finland. Each quantile includes 35 CZs. Exposure values for each CZ are calculated based on equations 6 and 7. The ranges from low to high quantile are: 0-0.1 %, 0.1-0.4 %, 0.4-0.8 %, 0.8-1.3 %, 1.3-11.2 %.

Figure 2 shows that direct exposure was high at the South-West coastal regions, including Turku and Rauma. Traditional manufacturing hubs, like Tampere and Lahti, were among the high exposed regions. Northern regions were among the least dependent. Furthermore, proximity to Finnish-USSR border was not an important determinant for export dependency. The range in the top quantile is wide and it extends from 1.3 percent to 11.2 percent. Consequently, only few observations are located in the upper end of exposure range. The range in other quantiles is substantially smaller.

Table 2 presents the population-weighted averages of exposures for different percentile groups.

Table 2: Regional population weighted averages of Soviet exposure, per percentile-groups

	Weighted averages per percentile-groups				
	All	0-50	50-100	75-100	90-100
	(1)	(2)	(3)	(4)	(5)
Direct exposure, %	1.13	0.31	1.37	1.92	4.20
	(0.10)	(0.03)	(0.16)	(0.24)	(0.86)
Upstream exposure, %	0.06	0.00	0.06	0.13	0.24
	(0.01)	(0.00)	(0.01)	(0.02)	(0.02)
Downstream exposure, %	3.62	1.97	4.74	6.16	10.42
	(0.37)	(0.18)	(0.28)	(0.51)	(0.64)
Number of observations	175	88	87	44	18

Notes: Averages are weighted by CZ's working-age population in 1989. Exposure calculations are based on equations 6-11. Standard deviations are in parenthesis.

Column 1 in table 2 shows that approximately 1.1 percent of working-age population was directly exposed to Soviet exports, 0.06 percent to upstream linkages and 3.6 percent to downstream linkages. The figures in column 2 are calculated among the least exposed half of CZs, showing that among these regions, 0.3 percent of people were directly exposed to Soviet exports. The corresponding figures for upstream exposure was 0.0, indicating that half of the regions were not exposed to upstream linkages. Downstream exposure among least exposed half was 2.0 percent. Column 5 shows the average exposure among the most exposed decile, 4.2 percent of population were directly exposed, 0.2 percent were exposed to upstream linkages and 10.4 percent to downstream linkages.

6 Results

The results are divided into three sections: First, I present the findings for direct effects using several regression specifications for regional population changes between 1989 and 1992. Secondly, I present the findings for different demographic groups for the same time period. Thirdly, I present the results for both direct and indirect effects for several time-periods.

In table 3, I complement the reduced form regression with regional controls. The dependent variable, regional population change, is measured in logarithmic counts.

Table 3: OLS-regression results for 1989-1992: Direct exposure to Soviet exports and change in working-age population in CZs

Dependent variable: change in log working-age population counts

	OLS-estimates: 1989-1992			
	(1)	(2)	(3)	(4)
Direct exposure, %	-0.227**	-0.170***	-0.182***	-0.266**
	(0.113)	(0.052)	(0.049)	(0.109)
Upstream exposure, %			-1.386	-2.014
			(1.158)	(1.482)
Downstream exposure, %			0.081*	0.103**
			(0.044)	(0.047)
Share of people living in owner-occupied housing, %		0.120***	0.122***	0.131***
		(0.032)	(0.033)	(0.041)
Regional characteristics	No	Yes	Yes	Yes
Broad industrial structure	No	No	Yes	Yes
Soviet import -exposure	No	No	No	Yes
Detailed manuf. structure	No	No	No	Yes
R^2	0.01	0.89	0.92	0.94

Notes: N=175 (CZs). Dependent variable: $\log(\text{pop}_{92}) - \log(\text{pop}_{89})$. Controls are calculated from pre-shock levels. Regional characteristics include age-structure (shares on 10-year intervals), share of people living in owner-occupied housing (renters omitted), employment rate among women, share of population with secondary and tertiary education (primary educated omitted) and employment rate among the education groups. Broad industry structure includes employment shares in 16 broad industries. Detailed manufacturing industries include 22 industries within broad manufacturing sector. All regressions are weighted by start-of-period CZs' population. Robust standard errors are in parenthesis. $***$ Significant at the 1 percent level. $**$ Significant at the 5 percent level. $*$ Significant at the 10 percent level.

Column 1 in table 3 presents the reduced form estimate, which implies that Soviet dependency was associated with regional population reductions in Finnish regions between 1989 and 1992. The coefficient suggests that a one percentage point increase in direct Soviet exposure implied a 0.4 percent relative reduction in region's working-age population between

1989 and 1992[8]. The reduction is measured against changes in other regions' populations. The estimate magnitude is higher than absolute change because a reduction in one region's population simultaneously increased the population in other regions.

If people in different age or education cohorts had different tendencies to move, the reduced form estimate could reflect regional demographic compositions. In column 2, I take into account differences in regional characteristics, including regions' education and age structures. The association between 1989 and 1992 population shifts reduces somewhat from the reduced form: a one percentage point increase implies 0.3 percent decrease in regional population.

As Finland experienced several industry shocks in early 1990s, it is important to control for regional industry structures so that the estimates do not capture the effects of other unobservable industry shocks. In column 3, I take into account regional industry structures and upstream and downstream Soviet export exposures. This controls for the potential effects through the supply-chain linkages and decomposes the shock into direct and indirect components. The coefficients are relatively stable across specifications in columns 2 and 3.

The main specification in column 4 takes into account detailed manufacturing industry structure and Soviet energy import dependencies. The coefficient of direct exposure somewhat increases from the reduced form estimate. A one percentage point increase in direct exposure implies a 0.5 percent relative reduction in regional working-age population. The findings suggests that a region at the 75th percentile exposure level was expected to experience a 0.4 percent larger relative reduction in its working-age population compared to a region at the 25th percentile[9].

In column 4, downstream exposure is associated with increases in regional working-age populations. A one percentage point increase in regional exposure predicted a 0.3 percent increase in regional population. A region at the 75th percentile exposure level was expected to experience a 1.0 percent larger relative increase in its working-age population compared to a

[8] Percentage change estimates of $\tilde{P}_r$ are calculated by reversing the logarithmic transformation. The predicted log-change can be transformed to percentage change in working-age population in the following way: $\Delta\tilde{P}_r = \log(P_{r1}) - \log(P_{r0}) = \quad \Leftrightarrow \quad \frac{P_{1r}}{P_{0r}} = 10^{\Delta\tilde{P}_r} \quad \Leftrightarrow \quad \frac{P_{1r}-P_{0r}}{P_{0r}} = 10^{\Delta\tilde{P}_r} - 1$, where P_{0r} is working-age population before and P_{1r} working-age population after the shock.

[9] Percentile values (non-weighted): Direct: 25th percentile: 0.13%. 50th percentile: 0.49 %, 75th percentile: 1.06 %. Downstream: 25th: 0.80 %, 50th: 2.46 %, 75th: 4.54 %. Upstream exposure: 25th: 0.00 %, 50th: 0.01 %, 75th: 0.06 %.

region at the 25th percentile. Column 4 shows that upstream exposure has a negative point estimate that is statistically insignificant. Furthermore, column 4 shows that the share of people living in owner-occupied housing is associated with population increases.

In table 4, I show how direct Soviet exposure predicts population shifts of different demographic groups.

Table 4: Regression results for 1989-1992: Direct Soviet exposure and change in demographic-groups' population in CZs. OLS-estimates.

Dependent variable: change in log working-age population counts

	By education level			By age group		
	Primary	Secondary	Tertiary	16-34	35-49	50-64
	(1)	(2)	(3)	(4)	(5)	(6)
A. Controlling for regional characteristics						
Direct exposure, %	-0.217***	-0.080	-0.275**	-0.230**	-0.041	-0.240***
	(0.050)	(0.057)	(0.126)	(0.101)	(0.059)	(0.069)
R^2	0.89	0.42	0.40	0.79	0.80	0.93
B. Controlling for broad industry structure and regional characteristics						
Direct exposure, %	-0.143**	-0.181***	-0.256**	-0.271**	-0.047	-0.220**
	(0.055)	(0.063)	(0.107)	(0.110)	(0.080)	(0.074)
R^2	0.91	0.58	0.52	0.84	0.82	0.94
C. Full controls						
Direct exposure, %	-0.151	-0.294*	-0.400*	-0.478**	0.001	-0.168
	(0.132)	(0.157)	(0.212)	(0.199)	(0.144)	(0.189)
R^2	0.93	0.66	0.67	0.88	0.88	0.94

Notes: N=175 (CZs). Regional characteristics, broad industry structure and full controls include identical controls as in table 4. Education level refers to the highest degree. All regressions are weighted by start-of-period CZs' population. Robust standard errors are in parenthesis. $***$ Significant at the 1 percent level. $**$ Significant at the 5 percent level. $*$ Significant at the 10 percent level.

Row A in table 4 shows that, when regional characteristics are taken into account, direct exposure predicted losses in primary and tertiary educated. Furthermore, young and older age groups present statistically significant reductions. Row B shows that by taking into account regional industry structures, the association between primary educated reduces and secondary educated increases. Other estimates remain largely similar.

The main specification with full controls in row C shows that young people showed higher tendency to move in response to the local demand shocks than other age groups. A one percentage point increase in direct exposure resulted in a 0.7 percent loss in young people.

Taking into account the relative size of young populations (details in table 11 in appendix E), the contribution of young people to total population responses was 56 percent.

Column 2 and 3 in row C show that secondary and tertiary educated showed a statistically significant responses to demand shifts. The coefficient for tertiary educated implies that a one percentage point increase in exposure translated into a 0.6 percent loss in tertiary educated. The corresponding figure for secondary educated was 0.5 percent. Taking into account the relative sizes of educated populations, secondary educated reductions contributed for around 40 percent of reductions and tertiary educated around 20 percent. Primary educated and older people showed negative but insignificant responses.

The decomposition of downstream shifts (table 12 in appendix F) suggest that the increases were driven by young and secondary educated people. A one percentage point increase in exposure implied a 0.4 increase in secondary educated and 0.4 increase in young population. Other groups show statistically insignificant responses.

Table 5 shows how the coefficients of direct and indirect exposures vary between different time-periods.

Table 5: Regression results for 1989-1994: Exposure to Soviet exports and change in working-age population in CZs, OLS-regressions, full-controls

Dependent variable: change in log working-age population counts

		Indirect exposure		
	Direct exposure (1)	Downstream (2)	Upstream (3)	R^2
1989-1991	-0.158*	0.058	-2.464**	0.93
	(0.081)	(0.035)	(1.101)	
1989-1992	-0.266**	0.103**	-2.014	0.94
	(0.109)	(0.047)	(1.482)	
1989-1993	-0.309**	0.157***	-2.350	0.94
	(0.129)	(0.060)	(1.886)	
1989-1994	-0.281*	0.189***	-2.776	0.95
	(0.151)	(0.069)	(2.219)	

Notes: N=175 (CZs). All regressions include full controls (table 4 for description). All regressions are weighted by start-of-period CZs' population. Robust standard errors in parenthesis. ∗∗∗ Significant at the 1 percent level. ∗∗ Significant at the 5 percent level. ∗ Significant at the 10 percent level.

Column 1 in table 5 shows that the effect of direct exposure was at its largest between 1989-1993. The deepening of effects suggest that local labor markets absorbed the effects gradually. The effect of an additional one percentage point increase in direct exposure deepens from -0.3 percent in 1991 to -0.5 percent in 1993. These results suggest that the average annual reduction in population was slightly higher shortly after the shock, in 1989-1991, than later, in 1989-1993.

Columns 2 in table 5 shows that downstream estimate increases between 1992 and 1994. The coefficient implies that an additional one percentage point increase in downstream exposure changes from 0.3 percent in 1992 to 0.6 percent in 1994. Column 3 shows that upstream exposure was statistically significantly associated with population changes only in 1989-1991.

6.1 Result discussion

The findings imply that local labor supply responded to the deterioration in local labor market conditions and the asymmetric shifts reallocated workforce based on the shocks' magnitudes. The population responses differed across demographic groups and young, secondary and tertiary educated showed higher tendency to move in response to the shock.

Interpreting the results through the spatial equilibrium framework presented in section 4, the varying responses can be either due to differences in monetary incentives or regional attachment. For example, as young people were more responsive to demand shocks than other age-groups, it is possible that they had lower regional attachment, such as family-ties, compared to others. Alternatively, the relatively large shifts in young population's employment rate (details in table 10 in appendix E.) suggest that they were more likely to react to regional risk of unemployment than others. The results, however, imply that the effects were not transmitted solely through the risk of unemployment because tertiary educated had higher employment rates than secondary educated but still showed higher tendency to move.

Another potential explanation for varying effects across demographic groups is endogenous amenity values. Diamond (2016) finds that, in the US, regional amenity values for high educated were determined as a function of the level of high-educated people in the region. Therefore, the demand shock's effects could potentially be amplified by this endogeneity.

When high-educated people moved out, the region potentially became even less attractive to other high-educated, amplifying the out-migration even further. The amplification increases based on how people value other similarly educated or aged people in the same region.

Different responses across age-groups could be due to future income prospects. Topel (1986) shows that future expectations play an important role in the regional adjustment process after economic shocks and older people respond less to economic incentives as their future income potential is more limitedly realized compared to younger people.

The results suggest that population responses partly mitigated the negative effects of the adverse labor demand shocks as people were able to improve their welfare by moving across regions. The negative welfare effects were more absorbed by less mobile groups that did not have enough economic incentives that would have exceeded the moving costs.

The result magnitudes among different demographic groups are largely in line with Bound and Holzer (2000) who find that a one percent shift in demand away from a region lead to a negative population response of 0.5 percent among college graduated cohort and no responses among people with only high school or less (comparable to primary and secondary educated). Furthermore, the results are in line with Foote et al. (2015) who find that mass-layoffs after the great recession in the US propagated out-migration. The comparison of results imply that even in the present of significant institutional differences and distinct time periods, the results across age and education groups are consistent.

Home-ownership is associated with population increases, suggesting that in regions with relatively high share of people living in owner-occupied housing, population responded less to adverse labor demand shocks. This could be due to several reasons. One explanation is proposed by Glaeser and Gyourko (2005) who use spatial equilibrium framework to show that housing prices incentivize residents of declining regions to stay. Another explanation is that home-ownership is correlated with confounding factors such as family-ties. I do not, however, distinguish between the explanations.

The results are relevant not only on national level but also at regional level. Moretti (2004) finds that, in the US, productivity of plants located in regions that experienced increases in college graduates were higher than in similar plants in regions with smaller increases in graduates. These findings imply that demand shocks could influence regional growth potential in regions not only directly but also through productivity externalities as tertiary educated were more mobile than other education-groups.

6.2 Result robustness

In this section, I aim to validate the empirical results with a falsification exercise and robustness tests. The goal of the falsification exercise is to argue that the conditional independence assumption holds by analyzing whether the Soviet exposure metrics capture population trends already before the export collapse in 1990.

Table 6: Falsification exercise: Past working-age population changes and Soviet exposure

Dependent variable: change in log working-age population counts

	Direct (1)	Downstream (2)	Upstream (3)	R^2
1988-1989	-0.065	0.060**	-1.539*	0.85
	(0.053)	(0.025)	(0.840)	
1989-1990	-0.029	0.011	-0.811	0.85
	(0.056)	(0.026)	(0.843)	

Notes: N=175 (CZs). All control variables are calculated from pre-shock levels. All regressions include full controls (table 4 for description). All regressions are weighted by start-of-period CZs' population. Robust standard errors in parenthesis. ∗∗∗ Significant at the 1 percent level. ∗∗ Significant at the 5 percent level. ∗ Significant at the 10 percent level.

Column 1 in table 6 shows that the direct Soviet exposure does not capture population trends shortly before the shock. The negative but insignificant estimates have lower magnitudes per year than after-shock estimates. Following this finding, I interpret the coefficients in the specifications with full controls in tables 3-5 as causal effects.

Columns 2 and 3 show that upstream and downstream exposure metrics capture population shifts already before the trade collapsed. In 1988-1989, the population changes are statistically significant to upstream and downstream dependency and estimate magnitudes largely correspond to estimates measuring after-shock changes. The finding could be due to two mechanisms: (1.) the coefficients capture the gradual fall in Soviet exports that took place already before 1990, or (2.) the metrics are correlated with general population trends. Because I do not distinguish between these two mechanisms, I interpret the findings as associations, not causal effects.

Next, I analyze whether the empirical results on Soviet exposure are robust to a change in the comparison year. Soviet exposure metrics are calculated using 1988 data but I use 1989 as the base year in the main regressions. If there were relative shifts in local manufacturing industry structures between 1988 and 1989, this could potentially influence the results. Table 7 presents regressions in which the comparison year is 1988 instead of 1989.

Table 7: Result robustness to base-year change: exposure to Soviet exports and working-age population in CZs, OLS-regressions

Dependent variable: change in log working-age population counts

	Direct (1)	Downstream (2)	Upstream (3)	R^2
1988-1991	-0.165*	0.158***	-4.662***	0.94
	(0.099)	(0.045)	(2.034)	
1988-1992	-0.258**	0.222***	-4.778**	0.94
	(0.128)	(0.056)	(2.426)	
1988-1993	-0.284*	0.286***	-5.292*	0.95
	(0.146)	(0.069)	(2.962)	

Notes: N=175 (CZs). All regressions include full controls. All regressions are weighted by start-of-period CZs' population. Robust standard errors in parenthesis. $***$ Significant at the 1 percent level. $**$ Significant at the 5 percent level. $*$ Significant at the 10 percent level.

Columns 1 in table 7 shows that the coefficients of direct exposure are robust to the change in base year. The estimate magnitudes are largely in line with the main regression estimates. These findings mitigate concerns that relevant shifts in regional industry structures occurred between 1988 and 1989. Columns 2 and 3 show that the indirect exposure estimates increase, which is likely due to the correlations between population changes in 1988-1989 that are documented in table 6.

In table 8, I estimate how sensitive the results are to additional control variables and sample splits. One general trend in migration in early 1990s was that the people moved from less populated regions to denser areas. To examine whether the metrics capture this trend, I add a population control in the model to account for the initial population levels. Another potential mechanism is that mobility was motivated by regional wage-differentials. In order to address this, I control for regional average wages to test whether wage-differentials were driving the results. Furthermore, I split the sample based on regional population size to find out whether the results hold when large or small regions are omitted from the regressions.

Table 8: Robustness to additional controls and sample splits:
Direct Soviet exposure and working-age population changes, OLS-regressions

Dependent variable: change in log working-age population counts

	1989-1992	1989-1993
A. Baseline regression, full controls	-0.266**	-0.309**
	(0.109)	(0.129)
	0.94	0.94
B. Add regional population control	-0.238**	-0.283**
	(0.114)	(0.135)
	0.94	0.95
C. Add regional wage control	-0.256**	-0.298**
	(0.113)	(0.134)
	0.94	0.94
D. Drop 25 CZs with highest population	-0.132	-0.183
	(0.105)	(0.116)
	0.81	0.81
E. Drop 25 CZs with lowest population,	-0.328***	-0.373**
	(0.123)	(0.155)
	0.94	0.95

Notes: N=175 (CZs). All control variables are calculated from pre-shock levels. All regressions include full controls (table 4 for description). All regressions are weighted by start-of-period CZs' population. Robust standard errors in parenthesis. R^2s are listed below standard errors. $***$ Significant at the 1 percent level. In row C, wage is measured in regional nominal wage average. In row D, I drop CZs with population higher than 26,500. In row E, I drop CZs with population lower than 2,020. $**$ Significant at the 5 percent level. $*$ Significant at the 10 percent level.

In table 8, comparing row A to rows B and C shows that the results are robust to additional population and wage controls. Robust results imply that neither differences in pre-shock regional population levels nor average wage-differentials drove the population changes. Rows D and E show that the results are sensitive to sample splitting: Row D shows that by dropping 25 CZs with highest population, the estimates decrease substantially and become insignificant. Row E shows that by dropping 25 lowest populated CZs, the estimates are larger and significant. These findings suggest that larger CZs are driving the results.

6.3 Caveats and limitations

The falsification exercise is limited by data availability. I have data from 1988 onward, which limits the scope of the exercise. The data includes only one year that is strictly before the collapse (1988-1989). Therefore, I cannot run an exercise that has a time-period of equal length as the main regressions. This diminishes the comparability of the exercise and the results. Another issue with the exercise is that the decline in Soviet exports started already before the collapse. Therefore, it might be that the metrics are capturing the pre-shock decline in exports.

Furthermore, the falsification exercise does not completely rule out the possibility that the conditional independence assumption is violated. If there was correlation with omitted, confounding factors that impacted population changes after 1990 but not before, the assumption would be violated. For instance, if Soviet exposure was negatively related to regional competitiveness, it could affect regional populations only after the economic downturn started to add pressure on firms when the depression deepened in early 1990s.

Estimated effects are subject to attenuation. Attenuation is due to the imprecision of measuring the shocks. First, I do not observe which plants exported goods to USSR but identify demand shocks through all manufacturers that produced certain exported items. Secondly, I quantify the exposure based on one year manufacturing data, which potentially causes imprecision if large projects, such as ships, happened to be finished in 1988 but were actually manufactured for several years because the value of a project is only recorded for a single year. In addition, it is likely that within the 6-digit commodity categories, there is variation between products, which would inaccurately identify affected manufacturers, increasing the attenuation further. Attenuation is larger for indirect exposure metrics because they are estimated from plant level input-usage but I do not identify which inputs were used to produce Soviet exported items, causing imprecision in measurement.

A central limitation of the empirical model is related to the interpretation of empirical estimate magnitudes. Firstly, the model does not allow to interpret the estimated coefficients as absolute reductions in regional populations. Rather, the estimates capture changes in regional populations in comparison to changes in other regions. This relative effect is larger than the absolute effects because people move from one region to another, which causes double-counting in the outcome variable. However, the difference between relative and absolute effects diminishes as the number of regions gets larger. However, the issue prevents creating a counterfactual measure, which would enable calculating how many moves the collapse induced in comparison to a situation where the export collapse did not occur. The problem could be addressed by using a different outcome variable based on out-migration instead of net-changes in regional populations. Out-migration would not include double-counting as it only captures one side of mobility.

The data on population changes does not include all the moves that were motivated by studies before 1994. Apart from few exceptions based on family-ties, moves to a municipality of study were not recorded as permanent before 1994 as the study related moves were seen as temporary (Väestötietolaki 17 §). However, after a legislative change in 1994 (Kotikuntalaki, 201/1994), region of residence was changed to corresponded the studying location if the studies lasted more than one year. Therefore, before 1994, the data is likely to exclude study-related moves and it is possible that this depressed the coefficients if local labor conditions encouraged people to start studying. The legislative change should be kept in mind when comparing results before 1994 and 1994 onwards.

7 Conclusions

In the thesis, I quantify how the collapse in Finnish exports to Soviet Union affected the level of populations in Finnish regions. Between 1989 and 1991, the share of Finnish exports going to Soviet Union dropped from 15 percent to less than 5 percent. The collapse was unanticipated and externally driven, which is why it offers plausible exogenous variation to measure local demand shifts. I examine how the demand shifts affected regional populations in response to the collapse.

In measuring the demand shifts, I use regional variation in the production of Soviet exported goods. I employ plant-level information on production and employment to quantify the share of regions' workers that were directly exposed to Soviet export production before the collapse. I associate the direct exposure metrics with population changes after the shock to quantify how the export collapse affected regional populations.

I find that the Soviet trade collapse reduced the level of working-age population in Finnish regions. The range of direct exposure extended from 0.0 to 11.2 percent and between 1989 and 1992, a one percentage point increase in direct exposure translated into a 0.5 percent reduction in local working-age population. The effect magnitude is measured against changes in other regions' populations. The population reductions were driven by tertiary and secondary educated and young people, suggesting that local demographic compositions were also affected by the shock. I control for various region specific characteristics, such as local industry structure. Furthermore, the results are robust to additional controls and a falsification exercise, showing that the direct exposure to Soviet exports did not predict changes shortly before the collapse.

I decompose the shock into direct and indirect effects. Along with the directly affected manufacturing plants, I identify upstream plants that produced inputs used by directly exposed plants and downstream plants that used outputs of the directly exposed plants. I find that upstream exposure predicted population reductions shortly after the shock. Conversely, downstream exposure predicted regional population increases after the shock. However, the falsification exercise shows that indirect exposures were related to population shifts already before the collapsed, which is why the relations are not interpreted as causal.

The results offer insights on how local labor markets are equilibrated after asymmetric demand shocks. The findings support the theoretical suggestions that moving patterns are driven by economic incentives and people move from worse-off regions to better-off areas after asymmetric local labor demand changes.

The thesis contributes to recent empirical literature that studies the effects of regional conditions on local labor market outcomes. In particular, the thesis is related to trade literature that uses trade shocks as quasi-natural experiments, which offer plausible exogenous variation to study causal effects. Furthermore, the results contribute to the emerging literature that examines the role of supply-chain linkages in the propagation of economic shocks.

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Appendices

Appendix A: Formal derivation of the export collapse's effects on local labor demand

Soviet export shock originated in the goods markets. Each Soviet-exported good, $c = 1, ..., n,$, faces a drop in demand quantity that is equal to commodity's export share before the collapse. Close to equilibrium, the change in market demand for commodity c is approximately[10]:

$$dQ_c \approx (1 - \gamma_c)\, Q_j - Q_j = -\gamma_c\, Q_c \tag{12}$$

where Q_c is market demand, p_c commodity price, γ_c the Soviet demand share before the trade collapse. a, b are constants.

A.1. Direct effects

Each region has a representative plant that produces Soviet exported goods with varying share of Soviet export demand. Plant j is the sole producer of commodity c. In this setting, plant's production function equals region's production function. Plant uses two factors of production, labor and capital, to produce outputs, Q_j (commodity subscripts are dropped to simplify notation). Plant's production function follows Cobb-Douglas technology:

$$Q_j = L_j^{\alpha_j^l} \overline{K}_j^{a_j}, \tag{13}$$

where L_j is number of workers, and K_j is the value of capital stock. Capital stock remains fixed, which is denoted by $\overline{K}$. Parameters $\alpha_j^l > 0$ and $a_j > 0$ are output elasticities of capital and labor. Elasticities sum to one, $\alpha_j^l + a_j = 1$, implying that the production technology has constant returns to scale and each input alone has decreasing returns.

Plant j operates in competitive input and output markets so it takes output prices, p_j, wage-level, w, and rental rate of capital, r, as given. In competitive markets, zero-profit

[10] Equation is an approximation because it ignores price changes. I do not assume any functional form for the underlying goods demand.

condition holds:

$$p_j Q_j = wL_j + rK_j \quad \text{so that} \quad \frac{dQ_j}{dL_j} = \frac{w}{p_j} \tag{14}$$

Furthermore, the output elasticity of labor for plant j is:

$$\alpha_j^l = \frac{dQ_j/Q_j}{dL_j/L_j} = \frac{dQ_j}{dL_j}\frac{L_j}{Q_j}, \tag{15}$$

Combining equations 3 and 4 yields the change in labor demand when output quantity changes:

$$\frac{dL_j}{dQ_j} = \frac{\alpha_j^l\, p_j}{w} \tag{16}$$

Goods market equilibrium determines the change in output demand, corresponding to output production. After the drop in Soviet demand share, γ_c, plant's output, Q_j, decreases in proportion to the drop.

By combining the equations (12) and (16) yields the change in plant j's labor demand as a function of the Soviet export shock:

$$dL_j \approx -\,\alpha_j^l\, \frac{p_j}{w}\, \gamma_c\, Q_j \; < 0, \quad \text{if} \quad \gamma_c > 0 \quad \text{and} \quad \alpha_j^l > 0, \tag{17}$$

which shows that the demand for labor depends on Soviet export share of produced commodity, γ_c, labor intensity of production, α_j^l, and the ratio of output prices and wages.

A.2. Upstream effects

Upstream effect arises from the producers of intermediate products. The model follows similar structure as the derivation of import effects on upstream industries in Acemoglu et al. (2016).

The market for intermediate good include several plants and each plant $i = 1, ..., n$, operates in perfectly competitive markets and follows Cobb-Douglas technology. In this setting, plant j uses inputs in its production. In particular, plant j uses the outputs of plant i in its production process. Plant j's production function is:

$$Q_j = L_j^{\alpha_j^l} \sum_{i=1}^{n} X_{ji}^{a_{ji}}, \tag{18}$$

where X_{ji} is the quantity produced by plant i that is used by plant j. Plant j produces one output (commodity subscripts are dropped for simplicity). Output elasticity of inputs is positive $\alpha_j^l > 0$ and $a_j^l > 0$ and have constant returns to scale:

$$\alpha_j^l + \sum_{i=1}^{n} a_{ji} = 1$$

Output elasticity of intermediate product produced by plant i is:

$$a_{ji} = \frac{dQ_j}{dX_{ji}} \frac{X_{ji}}{Q_j} \tag{19}$$

The reduction in firm j's use of inputs produced by plant i, denoted by X_{ji}, translates directly into a drop in plant i's production:

$$dX_{ji} = dQ_i \tag{20}$$

Following the zero-profit condition of plant j, its use of input produced by plant i is:

$$X_{ji} = \frac{a_{ji} p_j Q_j}{p_i} \tag{21}$$

Combining equation 21 with equations 20 and 12 and differentiating output quantity of plant i against output quantity of plant j, yields:

$$dQ_i = -\frac{a_{ji} p_j}{p_i} \gamma_c Q_j, \tag{22}$$

which shows that a drop in plant j production through Soviet export collapse translates into a drop in production of plant i. The drop in plant i's production depends on Soviet export share of plant j's production, γ_c, intensity in using intermediate inputs produced by plant i, denoted by a_{ji} and price of input p_i and output p_j.

Following the same logic as in compiling equation 17, the reduction in labor demand of intermediate input producer, i, is:

$$dL_i \approx \frac{\alpha_i^l\, p_i}{w}\, dQ_i \approx -\frac{\alpha_i^l\, p_i\, a_{ji}\, p_j}{w}\, \gamma Q_j < 0, \quad \text{if} \quad \gamma_c > 0 \quad \text{and} \quad a_{ji} > 0 \tag{23}$$

which underlines that the exposure in upstream plants is proportional to the directly exposed plant's reduction in production and the proportion is defined by the output elasticity of input. Therefore, the shock to output demand of plant j lowers the demand for labor also in the input producing plant i.

A.3. Downstream effects

Acemoglu et al. (2016) show that without price responses, downstream exposed plants were not affected. However, in presence of price changes, plants that were connected to export producers through downstream linkages faced a supply shock in their inputs that could have been either positive or negative. The drop in demand for Soviet exported goods creates a positive supply shock for firms that use these goods as inputs. However, if Soviet export producing plants are shut down, this results in negative supply shift for input-users.

Appendix B: Detailed information on control variables

All control variables are calculated from pre-shock levels (most commonly, 1989). Industry divisions, both broad and detailed, are based on Statistics Finland's 1995 standard (TOL95). TOL95-codes are listed in front of variable description. Details of calculations from raw-data are provided in the supplementary data-appendix. All control variables are listed below:

Regional characteristics

Education structure: Share of region's working-age people with different levels of education (highest degree): tertiary education, secondary education, primary education.

Age structure: Share of region's working-age people (age-cohorts):
15-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years.

Employment: Share of region's working-age women that were employed, share of region's working-age tertiary educated that were employed, share of region's working-age secondary educated that were employed, share of region's working-age primary educated that were employed.

Housing: Share of region's working-age people living in an apartment or house that is privately owned by one of the residents.

Broad industry structure:
Share of region's employed, working age people employed in:
01-02: agriculture, game husbandry, forestry, 05: fishing industry, 10-14: mineral extraction, 15-37: manufacturing (omitted if manufacturing industry structure is controlled for), 40-41: electricity,

gas or water maintenance,, 45: construction, 50-52: wholesale or retail trade, repairing of motor vehicles or private or household goods, 55: accommodation or restaurant industry, 60-64: transportation, storage or telecommunications, 65-67: financing, 70-74: real estate, leasing, research and development, business services, 75: civil service, defence, social insurance activity, 80: education, 85: health care or social services, 90-93: other social or private services, 95: household services, 97: international organizations or foreign representative offices, 99: international organizations or unknown industries (omitted in regression models)

Detailed manufacturing industry structure:
Share of region's employed, working-age people that were employed in manufacturing of
15: groceries or beverages, 16: tobacco, 17: textiles, 18: clothing or furs, 19: leather products, 20: timber, wood product, cork, wickerwork (furniture excluded), 21: wood pulp, paper, paper-products, 22: employed in publishing, printing press, video, audio and ADP imitation, 23: coke, oil products, nuclear fuel, 24: chemical products, synthetic fibre, 25: rubber or plastic products, 26: non-metallic mineral products, 27: employed in metals refining, 28: metal product (machinery excluded), 29: machinery and appliances, 30: office equipment and computers, 31: other electronic appliances, 32: radio, television and telecommunications equipment, 33: medical equipment, fine-mechanical equip, optical instruments and watches, 34: cars and trailers, 35: furniture, 36: furniture and other items (instruments, games, toys, sports equipment), 37: employed in recycling.

Soviet energy-import controls
Exposure to Soviet energy-imports. Share of region's workers that were exposed to Soviet import shock, calculated separately for direct, upstream and downstream plants. Detailed calculations provided in the next section of the appendix.

Appendix C: Constructing Soviet energy-import controls

In calculating energy imports, oil, gas and petroleum are taken into account (observed at 4-digit level in HS88 commodity classification). The metrics is based on the impact on manufacturers that used Soviet imported commodities in their production process:

(1) *Direct input-supply (imports)*: Plant used inputs that were imported from Soviet Union.

(2) *Output-demand via upstream-linkages (imports)*: Plant produced commodities that were used as inputs in plants that used Soviet imported inputs.

(3) *Input-supply via downstream-linkages (imports)*: Plant used inputs that were produced

by another plant that used inputs that were imported from Soviet Union.

C.1. Exposure to imports via direct input-supply

Direct imports exposure, IS_r^M, captures regional manufacturing production's reliance on Soviet imports[11]. Direct Soviet import dependency is calculated in the following way:

$$\theta_i^M = \left(\sum_c M_c \frac{\mu_{ic}}{S_c} \right) \frac{1}{\mu_i}$$

where θ_i^M, measures plant-level import exposure, M_c is commodity imports from Soviet Union, S_c commodity supply in domestic market (imports + domestic production), μ_{ic} is the Soviet imported input use for a plant and μ_i is its total input use. Regional import exposure (ME_r) is calculated by using plant's regional labor weights:

$$Direct_r^M = \sum_{i \in I(r)} \theta_i^M \frac{L_i}{L_r}$$

C.2. Exposure to importing plants via upstream-linkages

Upstream import-exposed inputs:

$$UL_m^M = \sum_i \theta_i^M \mu_{ic}$$

Plant-level upstream import-exposure:

$$\varphi_i^M = \left(\sum_c UL_c^M \frac{Y_{ic}}{S_c} \right) \frac{1}{Y_i}$$

where φ_i^M is the plant-level exposure to upstream linkages with directly exposed manufacturers. Regional upstream import-exposure:

$$UL_r^M = \sum_{i \in I(r)} \varphi_i^M \frac{L_i}{L_r}$$

[11] The supply shock to directly exposed companies inputs is a downstream shock. Therefore, the metrics is conceptually similar to downstream exposure to Soviet exports. The measure is otherwise identical but Soviet imports enter the plant-level downstream exposure equation instead of Soviet exports

C.3. Exposure to importing plants via downstream-linkages

Downstream import-exposed inputs:

$$DL_c^M = \sum_i \theta_i^M Y_{ic}$$

Plant-level downstream import-exposure:

$$\rho_i^M = \left(\sum_c DL_c^M \frac{\mu_{ic}}{S_c}\right)\frac{1}{\mu_i}$$

where ρ_i^M is the plant-level exposure to upstream linkages with directly import-exposed manufacturers.

Appendix D: Statistics on Soviet exposure

Table 9: High and low direct Soviet exposure values for CZs, 1988

Among CZs with population over 50,000

	High		Low	
	CZ	Exposure	CZ	Exposure
1.	Lahti	1.69 %	Lappeenranta	0.31 %
2.	Turku	1.63 %	Joensuu	0.42 %
3.	Tampere	1.52 %	Kuopio	0.46 %
4.	Pori	1.29 %	Hämeenlinna	0.48 %
5.	Kouvola	1.16 %	Oulu	0.77 %

Among all CZs

	High		Low	
	CZ	Exposure	CZ	Exposure
1.	Taivalkoski	11.15 %	Muonio	0.00 %
2.	Rauma	8.06 %	Valtimo	0.00 %
3.	Kyyjärvi	6.46 %	Utsjoki	0.00 %
4.	Mäntyharju	6.37 %	Savukoski	0.00 %
5.	Kesälahti	5.66 %	Ristijärvi	0.00 %

Appendix E: Descriptive statistics on Finnish labor markets

Figure 3: Total working-age population in Finland

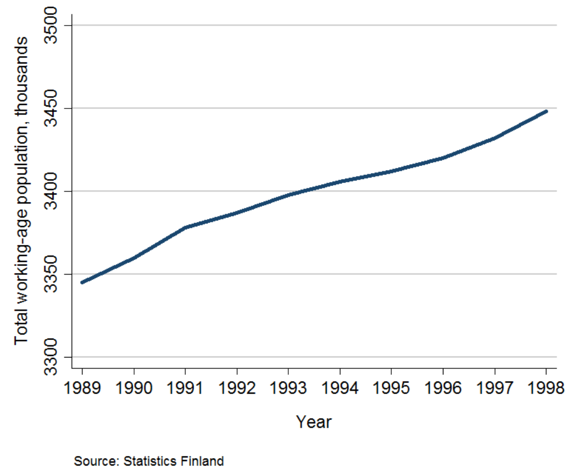
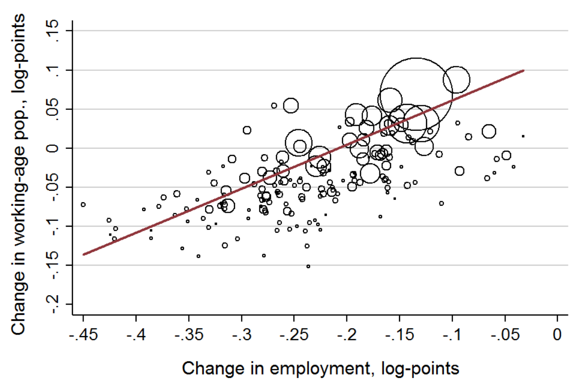
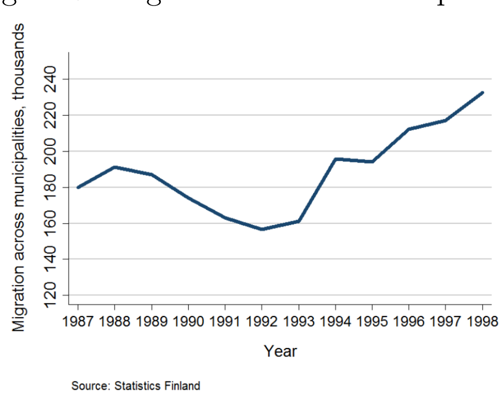


Figure 4: Changes in population and employment by CZ, 1989-1995



Source: Statistics Finland. Notes: N=172, 3 observations are outside the scale (0.16 percent of total working-age population). Changes are calculated in log counts. Marker-size indicates region's population share in 1989. In drawing the trend-line, observations are weighted by population shares in 1989.

Figure 5: Migration across municipalities



Notes: Absolute number of moves across municipalities, 1987-1998

Table 10: Descriptive statistics on CZ's employment

Year	1989	1993	1996
Employment			
among working-age population, %	56.46	44.52	47.56
	(2.59)	(2.31)	(2.18)
among primary educated, %	43.95	31.08	31.24
	(3.26)	(2.16)	(2.03)
among secondary educated, %	61.90	46.18	49.40
	(2.05)	(1.95)	(1.77)
among tertiary educated, %	76.37	66.05	68.74
	(0.53)	(1.31)	(1.21)
among young (16-34 years), %	57.78	38.45	41.55
	(2.36)	(2.25)	(2.35)
among mid-aged (35-49 years), %	69.00	58.97	62.33
	(1.97)	(1.98)	(1.71)
among old (50-64 years), %	40.16	35.90	38.03
	(3.25)	(2.70)	(2.45)
Employed in manufacturing, %	23.05	21.38	21.83
	(1.90)	(1.86)	(1.99)

Notes: Source: Statistics Finland. N=175. Averages are weighted by CZ's period working-age population. Standard deviations are in parenthesis. Manufacturing employment is calculated among employed population.

Table 11: CZ's population structure: weighted CZ-averages

Year	1989	1993	1996
Share of working-age population			
primary educated, %	44.17	40.20	36.58
	(0.92)	(0.70)	(0.69)
secondary educated, %	36.74	37.77	39.32
	(0.84)	(1.07)	(1.15)
tertiary educated, %	19.09	22.03	24.10
	(1.69)	(1.69)	(1.74)
young (16-34 years), %	40.51	38.75	37.51
	(0.45)	(0.52)	(0.65)
middle-aged (35-49 years), %	34.15	35.86	35.44
	(0.42)	(0.16)	(0.13)
old (50-64 years), %	23.48	23.49	25.15
	(0.77)	(0.58)	(0.49)
living in owner-occupied	74.80	71.72	69.24
housing, %	(2.11)	(2.44)	(2.72)

Notes: Source: Statistics Finland. N=175. Averages are weighted by CZ's period working-age population. Standard deviations are in parenthesis. Home-owners are calculated on household basis and the figure is among working-age population.

Appendix F: Supplementary empirical results

Table 12: Regression results for 1989-1992: Downstream Soviet exposure and change in demographic-groups' population in CZs. OLS-estimates.

Dependent variable: change in log working-age population counts

	By education level			By age group		
	Primary (1)	Secondary (2)	Tertiary (3)	16-34 (4)	35-49 (5)	50-64 (6)
A. Controlling for regional characteristics						
Export	-0.040	0.141***	0.207**	0.161*	0.065	-0.015
exposure, %	(0.052)	(0.053)	(0.089)	(0.093)	(0.035)	(0.057)
R^2	0.89	0.45	0.41	0.80	0.80	0.92
B. Controlling for broad industry structure and regional characteristics						
Export	0.027	0.100*	0.168*	0.123	0.066	0.029
exposure, %	(0.062)	(0.054)	(0.099)	(0.100)	(0.043)	(0.062)
R^2	0.91	0.58	0.52	0.84	0.82	0.93
C. Full controls						
Export	0.053	0.147**	0.148	0.155*	0.079	0.071
exposure, %	(0.063)	(0.065)	(0.107)	(0.094)	(0.056)	(0.074)
R^2	0.93	0.66	0.67	0.88	0.88	0.94

Table 13: Regression results for 1989-1992: Upstream Soviet exposure and change in demographic-groups' population in CZs. OLS-estimates.

Dependent variable: change in log working-age population counts

	By education level			By age group		
	Primary (1)	Secondary (2)	Tertiary (3)	16-34 (4)	35-49 (5)	50-64 (6)
A. Controlling for regional characteristics						
Export	-1.871	-0.057	-2.390	-3.554*	1.135	-1.299
exposure, %	(1.641)	(1.209)	(2.075)	(2.128)	(0.920)	(1.514)
R^2	0.89	0.42	0.39	0.79	0.80	0.92
B. Controlling for broad industry structure and regional characteristics						
Export	-0.984	-0.376	-2.343	-3.881*	1.290	-0.527
exposure, %	(1.536)	(1.085)	(2.381)	(2.156)	(1.039)	(1.407)
R^2	0.91	0.57	0.52	0.84	0.82	0.93
C. Full controls						
Export	-1.529	-2.038	-4.152	-4.373	-1.538	0.344
exposure, %	(1.948)	(1.550)	(2.930)	(2.950)	(1.557)	(1.897)
R^2	0.93	0.66	0.67	0.88	0.88	0.94

Notes on above tables: N=175 (CZs). All control variables are calculated from pre-shock levels. Regional characteristics, broad industry structure and full controls include identical controls as in table 4 (direct exposure is included in full controls). All regressions are weighted by start-of-period CZs' population. Robust standard errors are in parenthesis. $***$ Significant at the 1 percent level. $**$ Significant at the 5 percent level. $*$ Significant at the 10 percent level.