Impact of the China Trade Shock on U.S. Regional Inequality: A Replication Study

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Overview

Introduction

Research Question: The impact of a significant international trade shock on regional inequality in the US is examined.

Methodological Approach: A composition-adjusted Two-Stage Least Squares regression is employed, with demographic factors (gender, age, education, race, nativity) controlled to isolate shifts that might affect inequality across industries.

Key Findings: It is observed that the China shock has amplified regional inequality. By adjusting for composition, a stronger impact of increased Chinese imports on economic variables is revealed, especially on unemployment rates. Workers in industries heavily impacted by import competition are found to face unemployment rather than transitioning to higher-wage sectors.

The two main data sources used in this study are:

1. Dependent variables from the 1990, 2000 Censuses + 2007 3 year ACS (2006-2008)
   - `https://usa.ipums.org/usa/`
2. **Data II:** Independent variables from “China Syndrome” paper
   - **Author:** David H. Autor, David Dorn, and Gordon H. Hanson, 2013, “The China Syndrome: Local Labor Market Effects of Import Competition in the United States”
   - **Dorn Data:** `http://www.ddorn.net/data.html`

Data Description
Transformations

- *Step 1:* Ten-year equivalent changes (btw 1990-2000 and btw 2000-2007) are constructed at the commuting zone (CZ) level, composition-adjusted for working-age individuals (also the same for 1990 - 2000) for
  - average wage, e.g., log(average wage$_{2007}$) log(average wage$_{2000}$)
  - unemployment rate, e.g., unemployment rate$_{2007}$/unemployment rate$_{2000}$
  - labor force participation (LFP) rate, e.g., LFP rate$_{2007}$/LFP rate$_{2000}$
- *Step 2:* 2SLS is used to estimate the impact of the “China shock” on the CZ-level outcomes above, with progressive controls added for additional CZ-level variables as described in the paper.

The paper explores how changes in industry-level import exposure affect labor outcomes at the commuting zone level, specifically analyzing unemployment rates, wages, income levels, and labor force participation.

The primary estimation employs an Instrumental Variables Two-Stage Least Squares model[1]:

$$\Delta L_{it}^{m} = \gamma_t + \beta_1 \Delta IPW_{it}^{u} + \boldsymbol{X}_{it}' \boldsymbol{\beta}_2 + \epsilon_{it} \tag{1}$$

Where:

- ΔL_{it}^{m}: 10-year change in the average share[2] of manufacturing employment in the working-age population in commuting zone i and year t.
- γ_t: Time fixed effect.
- ΔIPW_{it}^{u}: Observed change in U.S. import exposure from China.
- $\boldsymbol{X}_{it}$: Set of control variables for demographic and labor force characteristics.

[1] Clustered by area using FIP code.
[2] Average calculated across groups based on gender, origin, age, education level, and ethnicity.

The results of the main model are compared with those from a model in which labor outcomes are adjusted to control for changes in population composition. This alternative model is:

$$\Delta L_{it}^{CA,m} = \gamma_t + \beta_1 \Delta IPW_{it}^{u} + \boldsymbol{X}_{it}' \boldsymbol{\beta}_2 + \epsilon_{it} \tag{2}$$

Where:

- $\Delta L_{it}^{CA,m}$: 10-year change in the composition-adjusted average share of manufacturing employment within the working-age population in commuting zone i for year t.

Original regression coefficients may be influenced by labor mobility between regions; therefore, composition adjustments are applied while aggregating the dependent variable by groups g.

In the case of the share of manufacturing employment within the working-age population L_{igt}, the composition adjusted average is defined as:

$$L_{it}^{CA} = \sum_{g} \bar{\theta}_{ig} L_{igt} \tag{3}$$

Where the time-invariant weights $\bar{\theta}_{ig}$ are defined as:

$$\bar{\theta}_{ig} = \frac{\theta_{ig1990} + \theta_{ig2000} + \theta_{ig2008}}{3} \tag{4}$$

and

$$\theta_{igt} = \frac{hours_{igt}}{\sum_g hours_{igt}}. \tag{5}$$

Where $hours_{igt}$ denotes the number of weekly hours worked by group g in commuting zone i at time t.

Main Results

Impact of Chinese Imports on Manufacturing Employment Proportion

Table 1: Imports from China and Change of Manufacturing Employment in CZs, 1990–2007: 2SLS Estimates[3]

	I. 1990–2007 stacked first differences											
	(1)		(2)		(3)		(4)		(5)		(6)	
	Original	CA	Original	CA	Original	CA	Original	CA	Original	CA	Original	CA
(Δ imports from China to US)/worker	-0.746***	-0.787***	-0.610***	-0.658***	-0.538***	-0.590***	-0.508***	-0.550***	-0.562***	-0.605***	-0.596***	-0.640***
	(0.068)	(0.085)	(0.094)	(0.118)	(0.091)	(0.091)	(0.081)	(0.100)	(0.096)	(0.117)	(0.099)	(0.120)
Percentage of employment in manufacturing$_{-1}$			-0.035	-0.034	-0.052***	-0.050***	-0.061***	-0.071***	-0.056***	-0.057***	-0.040***	-0.048***
			(0.022)	(0.021)	(0.020)	(0.019)	(0.017)	(0.016)	(0.016)	(0.015)	(0.013)	(0.013)
Percentage of college-educated population$_{-1}$							-0.008	-0.033*			0.013	-0.008
							(0.016)	(0.018)			(0.012)	(0.013)
Percentage of foreign-born population$_{-1}$							-0.007	-0.006			0.030***	0.036***
							(0.008)	(0.008)			(0.011)	(0.013)
Percentage of employment among women$_{-1}$							-0.054**	-0.027			-0.006	0.028
							(0.025)	(0.029)			(0.024)	(0.030)
Percentage of employment in routine occupations$_{-1}$									-0.230***	0.113	-0.245***	-0.214
									(0.063)	(0.309)	(0.064)	(0.247)
Average offshorability index of occupations$_{-1}$									0.244	-0.225***	-0.059	-0.247***
									(0.252)	(0.072)	(0.237)	(0.072)
Census division dummies	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
II. 2SLS first stage estimates												
(Δ imports from China to OTH)/worker	0.792***	0.792***	0.664***	0.664***	0.652***	0.652***	0.635***	0.635***	0.638***	0.638***	0.631***	0.631***
	(0.079)	(0.079)	(0.086)	(0.088)	(0.090)	(0.092)	(0.090)	(0.092)	(0.087)	(0.089)	(0.087)	(0.090)
R^2	0.54	0.54	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58

Notes: $N = 1,444$ (722 commuting zones $\times$ 2 time periods). All regressions include a constant and a dummy for the 2000–2007 period. First stage estimates in panel II also include the control variables that are indicated in the corresponding columns of panel I. Routine occupations are defined such that they account for 1/3 of US employment in 1980. The offshorability index variable is standardized to mean of 0 and standard deviation of 10 in 1980. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period CZ share of national population.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

[3] Equivalent to *Table 3* in the original paper, with additional columns for composition-adjusted models.

Impact of Chinese Imports on Manufacturing Employment Proportion (Interpretation)

- Composition-Adjusted estimates are consistently, albeit marginally, more negative than the original.
- In the model with all variables (6), the composition-adjusted $\beta = -0.640$ means that an exogenous increase of \$1,000.00 in per-worker exposure to Chinese imports leads to a predicted decrease of 0.64 percentage points in manufacturing employment per working-age population.
- The greater magnitude of the composition-adjusted estimates tells us that, had the composition of each CZ's population stayed fixed across time (aggregate to 128 sub-groups), exposure to exogenous Chinese import shocks would have resulted in a higher decrease in the share of working-age population employed in manufacturing.

Table 2: Imports from China and Employment Status of Working-Age Population within CZs, 1990–2007: 2SLS Estimates[4]

Dependent variables: Ten-year equivalent changes in log population counts and population shares by employment status	Mfg emp (1)		Non-mfg emp (2)		Unemp (3)		NILF (4)	
	Original	CA	Original	CA	Original	CA	Original	CA
Panel A. 100 × log change in population counts								
(Δ imports from China to US)/worker	-4.231***	-4.831***	-0.274	-0.013	4.921***	5.884***	2.058*	3.296*
	(1.047)	(1.215)	(0.651)	(0.667)	(1.128)	(1.138)	(1.080)	(1.103)

Notes: $N = 1,444$ (722 CZs × two time periods). All statistics are based on working age individuals (age 16 to 64). The effect of import exposure on the overall employment/population ratio can be computed as the sum of the coefficients for manufacturing and nonmanufacturing employment. All regressions include the full vector of control variables from column 6 of Table 1. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period CZ share of national population.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

The coefficients in this table represent the expected log change caused by Chinese import shocks in the number of working-age individuals in four categories of employment within CZs:

- Manufacturing employment
- Non-manufacturing employment
- Unemployment
- Labor force non-participation

[4] Equivalent to *Panel A of Table 5* in the original paper, with additional columns for composition-adjusted models. The full table is available in the appendix as Table 4.

Import Shocks Effects on Employment Status (Interpretation)

The coefficients should be interpreted as the changes in the number of individuals per employment status in log points for every $1,000 increase in import exposure per worker.

E.g., in the original model, a $1,000 per worker increase in import exposure reduces the number of workers in manufacturing employment by 4.2% (vs. the 4.8% of the composition-adjusted model).

- When composition-adjusting all estimates become more negative, except for the coefficient on non-manifacturing employment.
- Notably, the non-manufacturing employment coefficient is the only estimate to move closer to zero as a consequence of composition-adjusting. However, in both models this estimate remains statistically insignificant.
- Unemployment shows the largest difference in composition-adjusted model compared to the main one, increasing from 4.9% to 5.9%.

In conclusion, had the composition of each CZ stayed fixed through time we would have observed greater losses in manufacturing employment and greater hikes in unemployment and labor-force exits for same values of per-worker exposure to Chinese import shocks.

Table 3: Imports from China and Wage Changes within CZs, 1990–2007: 2SLS Estimates[5]

Dependent variable: Ten-year equivalent change in average log weekly wage (in log pts)	All workers (1)		Males (2)		Females (3)	
	Original	CA	Original	CA	Original	CA
Panel A. All education levels						
(Δ imports from China to US)/worker	-0.759***	-1.222***	-0.892***	-1.203***	-0.614***	-1.258***
	(0.253)	(0.290)	(0.294)	(0.329)	(0.237)	(0.285)
R^2	0.56	0.56	0.44	0.43	0.69	0.68
Panel B. College education						
(Δ imports from China to US)/worker	-0.757**	-0.903***	-0.991***	-1.129***	-0.525*	-0.598*
	(0.308)	(0.334)	(0.374)	(0.372)	(0.279)	(0.349)
R^2	0.52	0.31	0.39	0.18	0.63	0.40
Panel C. No college education						
(Δ imports from China to US)/worker	-0.814***	-1.182***	-0.703***	-1.104***	-1.116***	-1.304***
	(0.236)	(0.266)	(0.250)	(0.312)	(0.278)	(0.271)
R^2	0.52	0.60	0.45	0.48	0.59	0.70

Notes: $N = 1,444$ (722 CZs $\times$ two time periods). All regressions include the full vector of control variables from column 6 of Table 1. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period CZ share of national population.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

[5] Equivalent to *Table 6* in the original paper, with additional columns for composition-adjusted models.

Impacts of Chinese Import Shocks on Wages by Gender and Edcation (Interpretation)

Composition-adjusting increases the magnitude of all coefficients, meaning that, had the population composition of CZs stayed fixed, we would have observed a greater decrease in wages regardless of gender and education level.

E.g., a $1,000 increase in per-worker import exposure is expected to result in a 0.991 log-point decrease in average weekly earnings for college educated males in the orginial model, compared to a 1.222 decrease for the same population sub-group in the composition-adjusted model.

The rank order of coefficients is also mainted in the composition-adjusted model:

- College-educated males are more negatively affected than those with no college education.
- Females with no college education are more negatively affected than those who attended college.
- Considering all workers regardless of gender, those with no college education are more negatively affected than those who attended college.

Conclusions

- Our analysis, using composition-adjusted Two-Stage Least Squares (2SLS) models, highlights a more substantial impact of the China trade shock on regional inequality across U.S. labor markets.
  - **Stronger Decline in Manufacturing Employment**: Composition-adjusted results indicate a sharper drop in manufacturing employment in response to increased import exposure, reinforcing the vulnerability of manufacturing-dependent regions to trade shocks.
  - **More Pronounced Wage Declines**: The adjusted analysis reveals that wage reductions, especially among workers without a college education, are more significant than previously estimated. This impact is heightened by accounting for demographic shifts, underscoring the differential effect on lower-educated workers.
  - **Higher Unemployment and Non-Participation Rates**: The adjusted model shows a significant increase in unemployment and non-labor force participation within regions exposed to import competition. This trend is less apparent in the unadjusted results, demonstrating the importance of composition adjustments to accurately capture labor market displacement.
- In summary, our findings contrast with the unadjusted model by illustrating that composition adjustments amplify the observed effects, leading to a deeper understanding of the China trade shock's role in driving regional inequality.

Appendix

Table 4: Imports from China and Employment Status of Working-Age Population within CZs, 1990–2007: 2SLS Estimates

Dependent variables: Ten-year equivalent changes in log population counts and population shares by employment status								
	Mfg emp (1)		Non-mfg emp (2)		Unemp (3)		NILF (4)	
	Original	CA	Original	CA	Original	CA	Original	CA
Panel A. 100 × log change in population counts								
(Δ imports from China to US)/worker	-4.231***	-4.831***	-0.274	-0.013	4.921***	5.884***	2.058*	3.296*
	(1.047)	(1.215)	(0.651)	(0.667)	(1.128)	(1.138)	(1.080)	(1.103)
Panel B. Change in population shares								
All education levels								
(Δ imports from China to US)/worker	-0.596***	-0.640***	-0.178	-0.118	0.221***	0.218***	0.553***	0.539***
	(0.099)	(0.120)	(0.137)	(0.117)	(0.058)	(0.053)	(0.150)	(0.121)
College education								
(Δ imports from China to US)/worker	-0.592***	-0.510***	0.168	0.165	0.119***	0.052**	0.304***	0.293***
	(0.125)	(0.159)	(0.122)	(0.156)	(0.039)	(0.025)	(0.113)	(0.084)
No college education								
(Δ imports from China to US)/worker	-0.581***	-0.640***	-0.531***	-0.265*	0.282***	0.268***	0.831***	0.638***
	(0.095)	(0.107)	(0.203)	(0.146)	(0.085)	(0.070)	(0.211)	(0.160)

Notes: $N = 1,444$ (722 CZs × two time periods). All statistics are based on working-age individuals (ages 16 to 64). The effect of import exposure on the overall employment/population ratio can be computed as the sum of the coefficients for manufacturing and non-manufacturing employment. This effect is highly statistically significant ($p \leq 0.01$) in the full sample and in all reported subsamples, for both composition-adjusted and non-adjusted models. All regressions include the full vector of control variables from column 6 of Table 1. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period CZ share of national population.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

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