

Import Competition and the Great U.S. Employment Sag of the 2000s

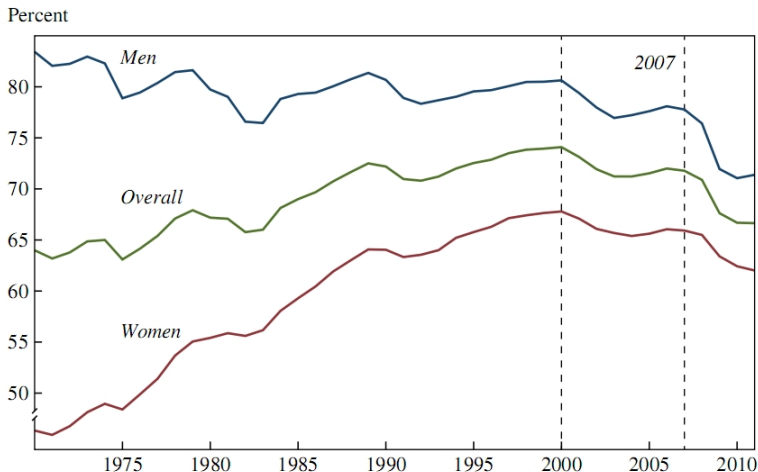
Daron Acemoglu David Autor
David Dorn Gordon Hanson Brendan Price

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From the Roaring 90's to the 'Great Sag'

Growth of U.S. employment rate decelerates after 2000

Figure 1. Employment-Population Ratios, Overall and by Sex, 1970–2011



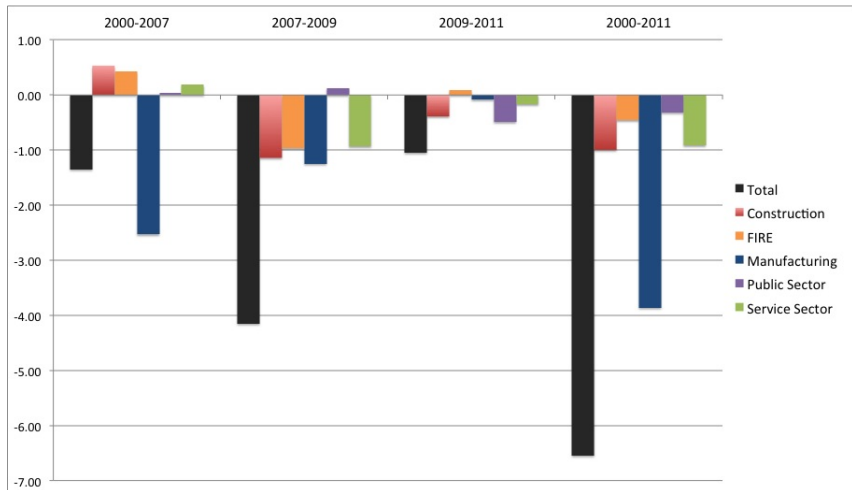
What do we know about the Great Sag?

Decline of employment rate is little understood (Moffitt '12)

- Potential causes
 - Wage levels, age structure, family structure, taxes, transfers, minimum wage policies, population health
- One factor has substantial explanatory power
 - Declining wage rates, particularly for males
- But why did employment, wages decline?
 - Suggests inward demand shift

Importance of manufacturing for the 'Great Sag' 2000-2011

OECD data: Emp by sector divided by pop age 15-64



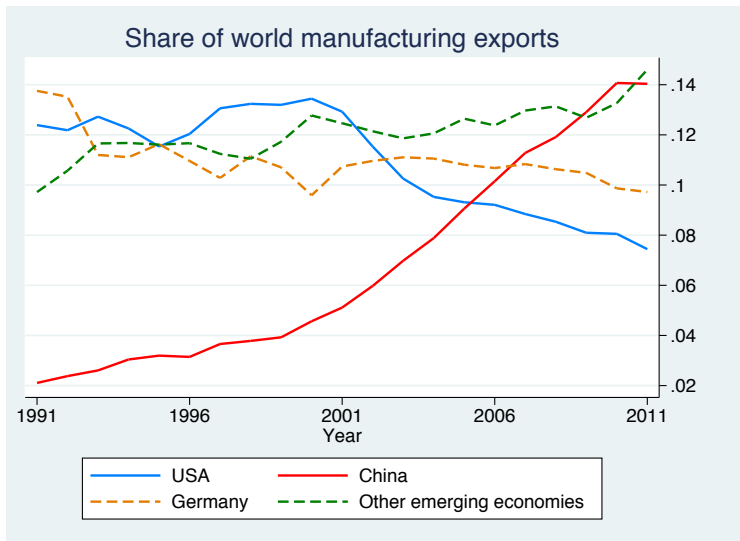
The Great Sag – ‘jobs deficit’

What if emp growth had not slowed in 2000s?

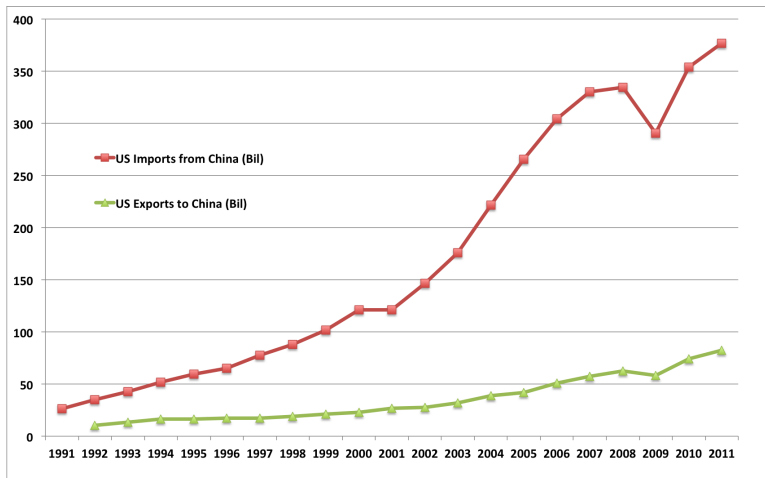
	Manufacturing	Non-Manuf
1991 Level (1,000s)	18,341	73,813
2000 Level (1,000s)	17,100	92,711
2007 Level (1,000s)	13,903	102,797
2011 Level (1,000s)	11,419	98,261
Growth Rate p.a. 91-00	-0.8%	+2.6%
Growth Rate p.a. 00-07	-2.9%	+1.5%
Growth Rate p.a. 07-11	-4.8%	-1.1%
2007 Counterfactual w/ 91-00 Growth	16,194	110,696
Jobs Deficit (1,000s)	-2,229	-7,898
2011 Counterfactual w/ 00-07 Growth	12,352	109,046
Jobs Deficit (1,000s)	-934	-10,785

Potentially underappreciated factor in U.S. employment

China's growing presence in world trade



Bilateral trade flows: U.S. – China imports and exports



Sources of China's export growth

Reforms that began in 1980s, had major impacts in 1990s & 2000s

- ① China initiates export-led development: mid 1980s
 - Deng's "reform and opening" (many limits on trade, FDI continue)
 - China's share of world manuf. exports: 1% in 1984, 2% in 1991
- ② Deng's rebound in 1992 leads to surge in FDI, spread of SEZs
 - Inward FDI in China/GDP: 1% in 1991, 6% in 1994
 - China's share of world manuf. exports: 2% in 1991, 12% in 2007
- ③ China's WTO entry in 2001 solidifies MFN status in US

Recent literature on labor market effects of trade

Impact on equilibrium wages and employment

Structural GE approaches

- Search frictions, specific human capital, firm exit costs
 - Cosar '11, Dix Carneiro '11, Cosar et al '11, Helpman et al '10 & '12, Burstein & Vogel '13, Fajgelbaum '13, Dix-Carneiro '14

Reduced-form approaches

- Adjustment at firm, industry or region level
 - Bernard et al '06, Verhoogen '08, Amiti & Davis '11, Bloom et al '12, Hummels et al '13
 - Goldberg & Pavcnik '03, Artuc et al '10, Ebenstein et al '10, McLaren & Hakobyan '11, Menezes-Filho & Muendler '11, Pierce & Schott '14
 - Borjas & Ramey '95, Chiquiar '08, Topalova '10, Kovak '13, Autor Dorn & Hanson '13

Effect of China competition on U.S. manuf employment

Sizable share of U.S. *manufacturing* employment decline due to China competition

- ① Bernard, Jensen, Schott '06 (plant-level analysis): 14% of decline in mfg employment '77—'97 due to low-income countries
- ② Pierce and Schott '14 (industry-level analysis): 16% reduction in employment growth of average industry '01—'07 due to China
- ③ Autor, Dorn and Hanson '13 (geo-level analysis): 25% of decline in mfg employment '00—'07 due to China
- ④ European evidence: Bloom, Draca and Van Reenen '12; Dauth, Findeisen and Südekum '13, Pessoa '14

What about *overall* employment impact?

Employment effects of Chinese import competition

Conceptual framework

National employment impact = Direct impact on exposed industries
+ Indirect impact on linked industries
+ Aggregate demand effects
+ Aggregate reallocation effects

Exercise 1: Industry-level analysis of import-exposed sectors

Industry-level analysis: Direct estimates for Δ U.S. manufacturing employment

$$\begin{aligned} \text{National employment impact} = & \text{Direct impact on exposed industries} \\ & + \text{Indirect impact on linked industries} \\ & + \text{Aggregate demand effects} \\ & + \text{Aggregate reallocation effects} \end{aligned}$$

Exercise 2: Industry-level analysis with input-output linkages

Add input-output linkages: Observe spillovers across industries

- disruption of supply chains may affect industries that sell to or by from directly exposed industries
- via input-output linkages, effect of goods trade in industries outside of manufacturing

$$\begin{aligned}\text{National employment impact} = & \text{Direct impact on exposed industries} \\ & + \text{Indirect impact on linked industries} \\ & + \text{Aggregate demand effects} \\ & + \text{Aggregate reallocation effects}\end{aligned}$$

Exercise 3: Local labor market-level analysis

Local labor market analysis: Observe sum of local GE effects

- local component of aggregate demand effect
- relocation of workers to non-exposed industries

$$\begin{aligned} \text{National employment impact} = & \text{Direct impact on exposed industries} \\ & + \text{Indirect impact on linked industries} \\ & + \text{Aggregate demand effects} \\ & + \text{Aggregate reallocation effects} \end{aligned}$$

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Mapping import shocks to U.S. employment

OLS approach

Ordinary least squares estimation

- Using observed Δ 's in Chinese industry import penetration

$$\Delta IP_{j,\tau} = \frac{\Delta M_{j,\tau}^{US,CH}}{Y_{j,91} + M_{j,91} - E_{j,91}}$$

- $\Delta M_{j,\tau}^{UC}$ is change in China imports over 1991 – 2011 in industry j
- $Y_{j0} + M_{j0} - E_{j0}$ is initial absorption: shipments, Y_{j0} , + imports, M_{j0} , – exports, E_{j0}

Eq'n follows from trade models w/gravity structure

- Response in demand for U.S. output to supply shock from China in the markets in which U.S., China compete

Isolating the supply shock component of China Imports

Instrumental variables approach

Problem

- US import demand Δ 's may contaminate estimation

Instrumental variables approach

- IV for US imports from China using other high income countries: Aus, Den, Fin, Ger, Jpn, Nzl, Spn, Swi
- Assumption: Common component of Δ in rich country imports from China is China export supply shock

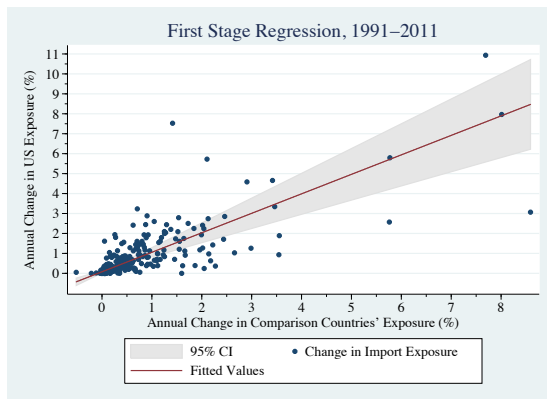
$$\Delta IPO_{j,\tau} = \frac{\Delta M_{j,\tau}^{OTH,CH}}{Y_{j,88} + M_{j,88} - E_{j,88}}$$

- Denominator: lagged value of shipments for industry j in '88

Isolating the supply shock component of China Imports

First stage regression

Figure 4. First Stage Regression, 1991-2011.



Alternative measures of trade exposure

Autor, Dorn, Hanson '13 explore five alternatives

- ① Use gravity model to estimate China export supply shock
- ② Add to imports from China imports from other low-wage countries
- ③ Include changes in import penetration in other US destination markets
- ④ Replace gross imports with net imports (in dollars or factor units)
- ⑤ Adjust for imports of intermediate inputs

These measures yield similar estimates in ADH '13

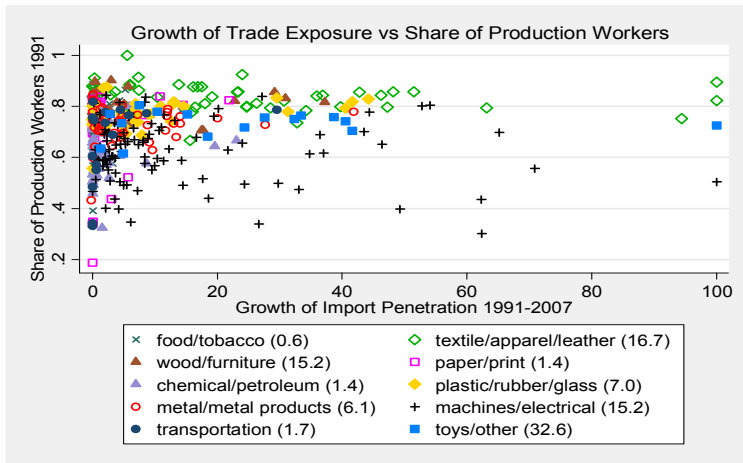
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Data sources

- ① International trade data 1991 – 2011 from UN Comtrade Database (6-digit HS products)
- ② U.S. employment from County Business Patterns: 1991, 1999, and 2011
- ③ NBER-CES Manufacturing Industry Database 1976 through 2009
- ④ U.S. Bureau of Economic Analysis 1992 input-output table for the U.S. economy

Direct import exposure at the industry level



Notes: Numbers in parentheses in the legend indicate average growth of import penetration within industry group, weighted by 1991 employment. Values for growth of import penetration are winsorized at 100.

Avg Δ import pen. p.a. is 0.3 (sd 0.8) in 1990s, 0.8 (sd 1.5) in 2000s.

Estimation: Basic regression model

Outcome var: Change in log industry employment, 1991-1999 and 1999-2011

- $\Delta \ln EMP_{j\tau} = \alpha_\tau + \beta_1 \Delta IP_{j\tau} + \gamma X_{j0} + e_{j\tau}$
 - $\Delta \ln EMP_{j\tau}$ is $100 \times \Delta \ln(\text{employment})$ p.a.
 - $\Delta IP_{j\tau}$ is import exposure index ($100 \times$ annual Δ)
 - $\Delta IP_{j\tau}$ is instrumented by $\Delta IPO_{j\tau}$
 - X_{j0} comprises industry-level controls

Controlling for industry-level confounds

① Confound: Technology and capital intensity

- Trade \leftrightarrow Technical change?
- *Controls*: Prod'n worker share, $\ln(\text{wagebill}/\text{emp})$, capital/value-added, computer + high-tech equipment invest share

② Confound: Long run decline in U.S. manufacturing

- Are the 'affected' inds declining prior to China shock?
- *Controls*: Pretrends in industry employment and earnings: Δ ind share of U.S. emp, Δ log of ind average wage 1976–1991

③ Confound: Trends in manufacturing sub-sectors

- Most exposed: Toys, sports equipment; apparel; electronics
- Least exposed: Food; chemical + petroleum; transportation
- *Controls*: Subsector dummies, industry FEs

Direct effect estimates: 1991-2011

Effect of Import Exposure on Manufacturing Emp, 1991-2011

Dep. Var.: 100 x Annual Log Δ in Employment

	OLS (1)	2SLS (2)	2SLS (3)	2SLS (4)	2SLS (5)	2SLS (6)	2SLS (7)
100 x Annual Δ in US Exposure to Chinese Imports	-0.81*** (0.16)	-1.30*** (0.41)	-1.10*** (0.35)	-1.33*** (0.43)	-0.75*** (0.22)	-0.74*** (0.22)	-0.60*** (0.29)
Production Controls	No	No	Yes	No	No	No	No
Pretrend Controls	No	No	No	Yes	No	Yes	No
1-Digit Mfg Sector Controls	No	No	No	No	Yes	Yes	No
4-Digit Industry FEs	No	No	No	No	No	No	Yes

Notes: Each column reports results from stacking log employment changes and changes in US exposure to Chinese imports over the periods 1991-1999 and 1999-2011 ($N = 784 = 392$ 4-digit manufacturing industries \times 2 periods). Observations are weighted by 1991 employment. Standard errors in parentheses are clustered on 135 3-digit industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Converting regression results to estimated job losses

- ① Multiply coefficient from model w/o sector FEs with observed change in industry-level US import penetration
- ② Multiply the product with 0.56 (r^2 of first stage regression) to capture only the shift in import penetration that we attribute to the Chinese supply shock
- ③ Convert from log employment changes in industries to headcounts

Contribution of import competition to employment decline

Implied Emp Changes Induced by Growing Import Exposure

Analysis	Affected Sector(s)	<u>Implied Employment Changes</u>		
		1991-1999	1999-2011	1991-2011
A Industry	Manufacturing	-277k	-560k	-837k

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Adding Input-output linkages

Downstream — Industry j sells to trade-exposed industry g

- Adverse effect on j : Reduces demand for j 's output

Upstream — Industry j buys from trade-exposed industry g

- Ambiguous effect on j
- May reduce j 's costs *or* may destroy existing long-term relationships

Adding input-output linkages

Examples for sectoral linkages outside of manufacturing

- ① Fertilizer mining industry (non-manuf)
 - Sells 85% of output to manufacturing, 1/4th to phosphatic fertilizer industry
- ② Iron and ferro-alloy ores (non-manuf)
 - Sells 92% of output to manufacturing sector, 2/3^{rds} to blast furnace and steel mill industry
- ③ Service industries with substantial sales to mfg: wholesale trade, equipment leasing, repair, advertising

Measuring Indirect Trade Exposure

Measurement (downstream exposure)

$$\Delta IP_{j\tau}^D = \sum_g w_{gj}^D \Delta IP_{g\tau}$$

- where w_{gj}^D is the fraction of all sales by industry j that go to industry g
- analogous measurement for upstream exposure

Extension

- Derive weights from Leontief inverse of industry I-O matrix to account for higher-order linkages

Descriptives: indirect exposure

Direct, Downstream, and Upstream Import Shocks, 1991-2011

	<u>Mfg Ind (N = 392)</u>	<u>Non-Mfg Ind (N = 87)</u>
	<u>Mean/SD</u>	<u>Mean/SD</u>
<u>Direct Import Shocks</u>		
Direct Shock	0.50 (0.94)	
<u>First-Order Indirect Shocks</u>		
Downstream Shock	0.16 (0.26)	0.03 (0.04)
Upstream Shock	0.10 (0.11)	0.03 (0.04)
<u>Full Indirect Shocks</u>		
Downstream Shock	0.24 (0.35)	0.06 (0.07)
Upstream Shock	0.14 (0.13)	0.05 (0.05)

Models that include input-output linkages, 1991-2011

2SLS Estimates Incorporating Input-Output Linkages.

Dep. Var.: 100 x Annual Log Δ in Employment

	<u>Mfg Only (N = 784)</u>		<u>Non-Mfg (N = 174)</u>		<u>Pooled (N = 958)</u>		
	(1)	(2)	(4)	(5)	(6)	(7)	(8)
Direct Trade Shock	-1.17*** (0.42)	-1.28*** (0.49)			-1.14*** (0.42)	-1.11** (0.48)	-1.18*** (0.42)
Downstream Shock	-2.21* (1.14)	-2.44** (1.13)	-6.63** (2.79)	-6.88** (2.97)	-2.70** (1.26)	-2.64* (1.32)	-1.90** (0.86)
Upstream Shock		2.31 (2.66)		-5.80 (7.43)		-0.67 (3.69)	
Higher-Order I-O	No	No	No	No	No	No	Yes

Notes: Each column stacks changes in log employment and changes in direct, upstream, and downstream import exposure over the periods 1991-1999 and 1999-2011. Purchase and sales shares are taken from the Bureau of Economic Analysis's 1992 benchmark input-output table. Observations are weighted by 1991 industry employment, and standard errors in parentheses are clustered on 3-digit industry (with each non-manufacturing industry constituting its own cluster). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Analysis	Affected Sector(s)	Implied Employment Changes		
		1991-1999	1999-2011	1991-2011
A Industry	Manufacturing	-277k	-560k	-837k
B1 Industry	Total	-556k	-1,581k	-2,137k
w/ I-O Links	Manufacturing	-404k	-928k	-1,332k
(First Order)	Non-manufacturing	-152k	-653k	-805k

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(First Order)	Non-manufacturing	-152k	-653k	-805k
B2 Industry	Total	-645k	-1,979k	-2,624k
w/ I-O Links	Manufacturing	-421k	-985k	-1,406k
(Full)	Non-manufacturing	-224k	-994k	-1,218k

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Industry vs local labor market analysis

Limitations of industry-level analysis

- ① Cannot observe aggregate demand effect: Reduced earnings and lower spending lower aggregate demand. Employment effect in industry with zero direct+indirect trade exposure industry may be negative.
- ② Cannot observe relocation effect: Some workers reallocate from trade-exposed to other industries. Employment effect in industry with zero direct+indirect trade exposure industry may be positive.

Industry vs local labor market analysis

Local labor market analysis can capture the *local component* of these GE effects

- ① Reduction in local spending will reduce demand for locally produced outputs, particularly non-tradables.
- ② Little worker mobility across local labor markets in response to trade shocks (Autor, Dorn, Hanson, Song '14); relocation effects should be mostly local.

Measuring Trade Exposure at CZ level

Autor, Dorn, Hanson, Song '14: Measure Δ CZ's import exposure as weighted average of exposure in the CZ's industries

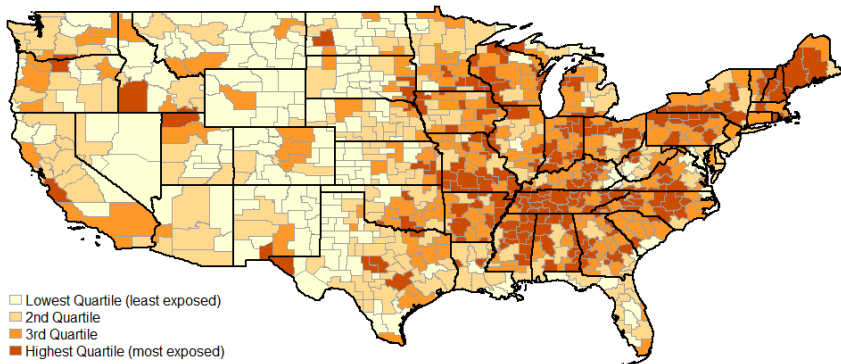
$$\Delta IPCZ_{i\tau} = \sum_j \frac{E_{ij\tau}}{E_{i\tau}} \Delta IP_{j\tau}$$

Instrumental variables approach

- Analogous measure: employment-weighted average of industry-level instrument

Geography of Trade Exposure

Trade Exposure by Commuting Zone, 1990-2007



Estimation: CZ regression model

Outcome var: Change in sector employment/working age pop, 1991-1999 and 1999-2011

- $\Delta EP_{is\tau} = \alpha_{s\tau} + \beta_1 \Delta IPCZ_{i\tau} \times 1[Exposed_s] + \beta_2 \Delta IPCZ_{i\tau} \times (1 - 1[Exposed_s]) + \gamma X_{is0} + e_{is\tau}$
 - $\Delta EP_{is\tau}$ is $100 \times$ Sector Emp/Pop for CZ i , sector s
 - $\Delta IPCZ_{i\tau}$ is import exposure in CZ i , instrumented by $\Delta IPCZ_{i\tau}^{OTH}$
 - $1[Exposed_s]$ is a dummy for trade-exposed sector (comprising industries with non-negligible direct/indirect exposure)
 - X_{is0} comprises CZ \times sector controls

Models of local labor market exposure

2SLS Estimates of Import Effects on Commuting Zone Emp/Pop Ratios Dep. Var.: $100 \times \Delta$ in (Local Emp in Sector / Local Working-Age Pop)

	<u>Overall Employment</u>		<u>Sectoral Employment</u>	
	(1)	(2)	(3)	(4)
Commuting Zone Import Shock	-1.64*** (0.46)	-1.70*** (0.78)		
Commuting Zone Import Shock x 1{Exposed Sector}			-1.95*** (0.16)	-1.68*** (0.24)
Commuting Zone Import Shock x 1{Non-Exposed Tradable Sector}			-0.01 (0.06)	-0.00 (0.11)
Commuting Zone Import Shock x 1{Non-Exposed Non-Tradable Sector}			0.33 (0.39)	-0.01 (0.57)
Sector x Time Effects	Yes	Yes	Yes	Yes
Sector x Mfg Emp Share at Baseline	No	Yes	No	Yes
Sector x Census Division	No	Yes	No	Yes
N	1444	1444	2888	2888

Notes: Each column reports results from stacking changes in commuting zone employment-to-population ratios and changes in commuting zone exposure to Chinese imports over the periods 1991-1999 and 1999-2011. Observations are weighted by commuting zone population as of 1991. Standard errors in parentheses are clustered on commuting zone. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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w/ I-O Links	Manufacturing	-421k	-985k	-1,406k
	Non-manufacturing	-224k	-994k	-1,218k
C Commuting	Total	-743k	-2367k	-3,110k
Zone	Exposed industries	-737k	-2348k	-3,086k
	Non-exposed tradables	0	-1k	-1k
	Non-exposed non-tradables	-5k	-17k	-23k

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Role of import competition in the 'great' U.S. employment sag of the 2000s?

- ① **Industry and I-O analysis: important inter-industry spillovers**
 - substantial trade-induced job losses not only in manufacturing but also in linked non-manufacturing
- ② **CZ analysis: imperfect local reallocation**
 - local employment decline in trade-exposed industries not offset by gains in non-exposed industries
 - negative aggregate demand effects at local level and labor market frictions will slow reallocation
- ③ **Import competition from China contributes to “Great Sag”**
 - Job loss accelerates from -0.7m jobs in 1990s to about -3m jobs in 2000s