The Impact of Trade and Technology on Task Demands: Evidence from Local Labor Market

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Two Large External Forces Operating on Labor Markets

1. Technological Change
   - Routine-task replacing technical changes
   - Polarization of labor markets as one potential consequence
2. Trade and Offshoring
   - Offshoring of jobs not requiring 'in-person' interactions (Blinder '05, Blinder-Krueger '09)
   - Displacement of white collar workers (Liu and Trefler '11)
   - Potential complementarity of offshoring/task trade w/low-skill domestic labor (Grossman-Rossi-Hansberg '08)

Trade and Technology Typically Studied in Isolation

Does it matter? Depends:

1. Are they correlated—impacting same occupations, industries, local labor markets?
2. Do they have distinct causal effects?

Why it might matter:

1. Misleading inferences: Could mistakenly attribute to trade what is caused by technology, or v.v.
2. Disentangling competing hypotheses:
   - Does offshoring replace 'routine' tasks, 'white collar' tasks, or something else?
   - Does offshoring augment low-skilled labor or displace low-skilled labor?
   - Are there important empirical differences btwn trade in *goods* and trade in *tasks*?

Some Empirical Work on Joint Impacts of Techology and Trade

- Measures of tasks and 'offshorability:'
  - Goos, Manning and Salomons '10: Job polarization across EU countries
  - Autor-Dorn '10: Job polarization across U.S. local labor markets
  - Firpo, Fortin and Lemieux '11: Polarization of U.S. wage structure in '90s
- Direct measures of service offshoring:
  - Liu and Trefler '11: Effect of offshoring on job changes, wage changes for U.S. workers
- What's missing:
  - Compelling measures of trade *and* technology in same regression

Our Contribution

Three empirical tools

1. Field-tested measure of 'computerizability': *Routine-task intensity*
   - Autor-Dorn, Goos-Manning-Salomons, Michaels-Natraj-Van-Reenen '11
2. Plausibly exogenous variation in trade exposure:
   - China trade exposure: instrumented U.S.-China trade interacted with local industry mix. [Autor-Dorn-Hanson '11]
3. Well defined unit of exposure:
   - Local U.S. labor markets (722): Commuting Zones (CZ's) [Autor-Dorn, Autor-Dorn-Hanson]
   - Both technology + trade shown to impact CZs

But no measure of (or exogenous variation in) service offshoring

- We are only considering trade in *goods* for now

Agenda

1. Empirical strategy
    1. Defining local labor markets: CZs
    2. Measuring CZ-level trade exposure
    3. Measuring CZ-level exposure to technical change
2. Results
    1. Technology, trade and manufacturing employment
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    3. Technology, trade and occupational structure
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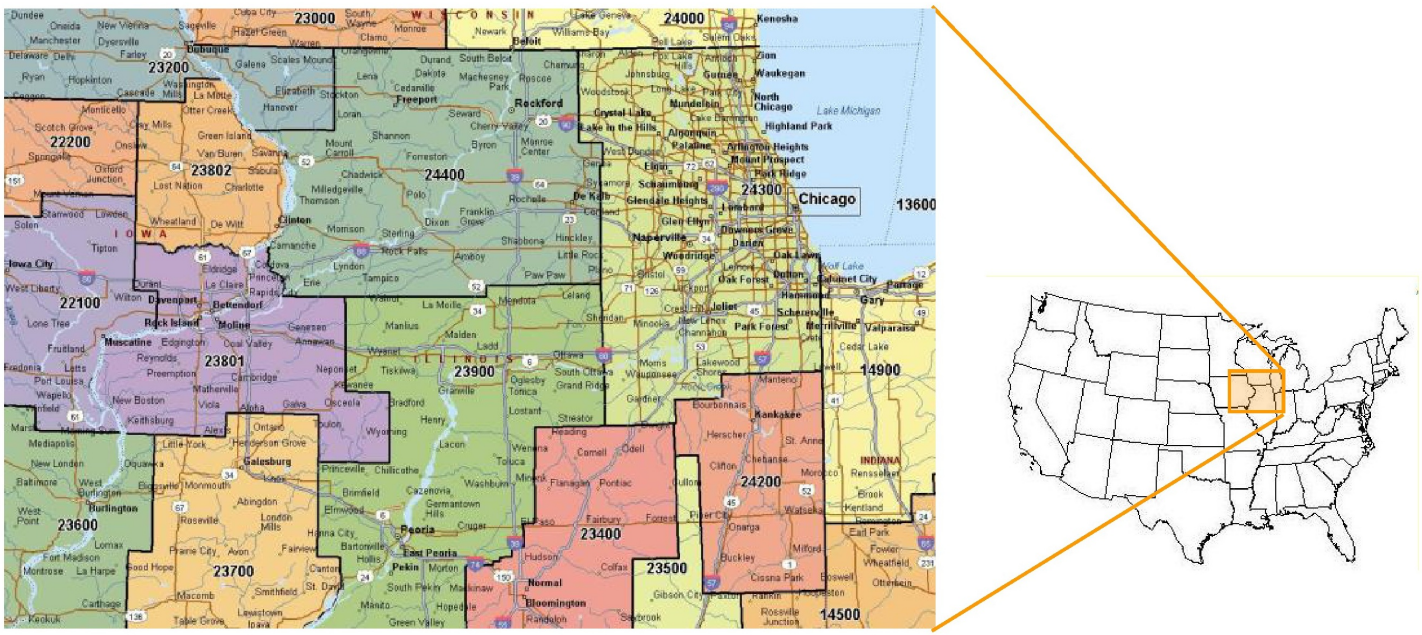
Defining Local Labor Markets

Commuting Zones–CZs: [Tolbert and Sizer '96]

- Based on commuting patterns among countries in 1990
- Cluster all mainland U.S. counties in 722 commuting zones, characterized by strong commuting ties, commutable distance
- Can map Census Public Use Micro Areas to CZs



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Ratio of Chinese imports to U.S. domestic consumption

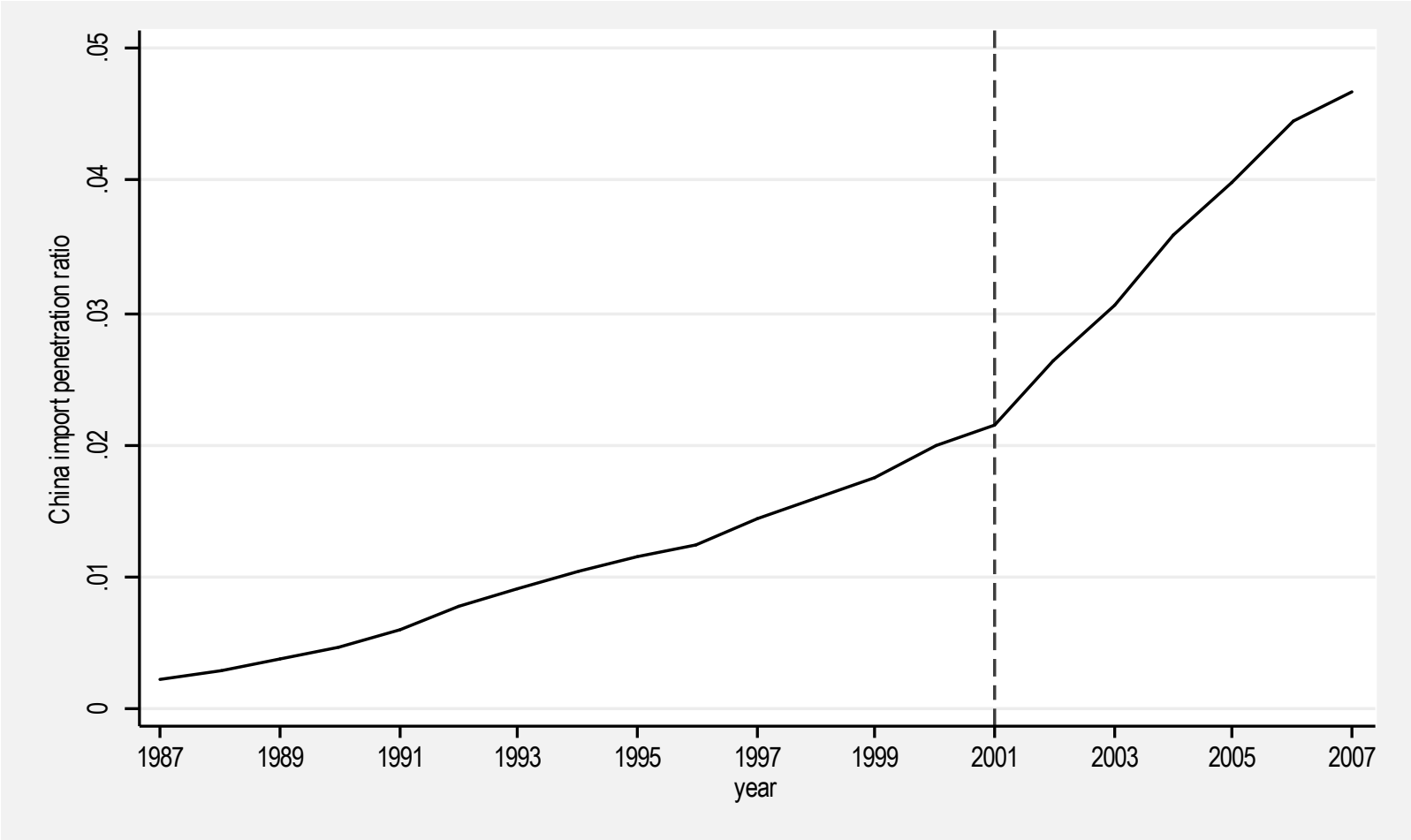


Figure 1.
Import Penetration Ratio for U.S. Imports from China.

Value of trade with China

Table 1. Value of Trade with China for the U.S. and Other Selected High-Income Countries and Value of Imports from all other Source Countries, 1991/1992-2007.

	I. Trade with China (in BN 2007 US$)		II. Imports from Other Countries (in BN 2007 US$)		
	Imports from China (1)	Exports to China (2)	Imports from Other Low-Inc. (3)	Imports from Mexico/Cafta (4)	Imports from Rest of World (5)
			A. United States		
1991/92	26.3	10.3	7.7	38.5	905.8
2000	121.6	23.0	22.8	151.6	1865.5
2007	330.0	57.4	45.4	183.0	2365.9
Growth 1991-07	1156%	456%	491%	375%	161%
			B. 8 Other Developed Countries		
1991/92	28.2	26.6	9.2	2.8	1708.8
2000	94.3	68.2	13.7	5.3	1979.8
2007	262.8	196.9	31.0	11.6	3339.3
Growth 1991-07	832%	639%	236%	316%	95%

Notes: Trade data is reported for the years 1991, 2000, and 2007, except for exports to China which are first available in 1992. The set of "Other Developed Countries" in Panel B comprises Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. Column 3 covers imports from all countries that have been classified as low-income by the World Bank in 1989, except for China. Column 4 covers imports from Mexico and the Central American and Carribean countries covered by the CAFTA-DR free trade agreement. Column 5 covers imports from all other countries (primarily from developed countries).

Recent literature on the effect of trade shocks

- **Plants**: Bernard, Jensen & Schott '06; Bloom, Draca & Van Reenen '10; Holmes & Stevens '11: Import exposure affects plant growth, size distribution, productivity
- **Industries**: Artuc, Chaudhuri & McLaren '10; McLaren & Hakobyan '11: Adjustment costs for workers in exposed industries
- **Occupations**: Ebenstein, Harrison, McMillian & Phillips, '10: Slower wage growth in occupations more exposed to imports
- **Factor content of trade**: Burstein & Vogel '11 (Deardorff & Staiger '88, Borjas, Freeman & Katz '97, Krugman v. Leamer '00)

Connections to the Lit

1. **Area studies of trade impacts**
   - Borjas & Ramey '95, Topalova '10, Kovak '11
2. **Area studies of local labor market responses to shocks**
   - Card '90; Blanchard and Katz '92; Bartik '93; Bound and Holzer, '99; Notowidigdo '11
3. **Local multipliers**
   - Nakamura and Steinson '11; Shoag '11, others
4. **Consequences of worker displacement**
   - Jacobson, LaLonde and Sullivan '93; Van Wachter, Song, Manchester '09; Couch and Placzek '10

Proxying for Δ Chinese import exposure at CZ level

- **Empirical proxy for Δ CZ's import exposure:**

$$\Delta IPW_{uit} = \sum_j \frac{E_{ijt}}{E_{jt}} \frac{\Delta M_{ucjt}}{E_{it}}$$

  - ΔIPW_{uit} = Change in U.S. imports per worker in CZ i during decade t
  - E_{ijt}/E_{jt} is CZ $i's$ share of U.S. employment in industry (good) j
  - E_{it} is total employment in commuting zone i
  - ΔM_{ucjt} is the $ growth in U.S.-China imports of good (industry) j

- ΔIPW_{uit} **is trade-induced demand shock for CZ's goods output**

Proxying for Δ Chinese import exposure at CZ level

$$\Delta IPW_{uit} = \sum_j \frac{E_{ijt}}{E_{jt}} \frac{\Delta M_{ucjt}}{E_{it}}$$

- **What this measure does:**
  - Allocates to each CZ a share of total national import growth
  - Divides this import value by a CZ's total employment
  - Yields measure of "import growth per worker" (in $1,000's of USD)
- **Note two sources of variation in this measure:**
  1. Variation in CZ's manufacturing industry *mix*
  2. Overall manufacturing employment *share* in CZ
     (By controlling for initial manufacturing employment in CZs, identification comes from variation in industry mix)

IV strategy: Exogenous variation in Chinese import shocks

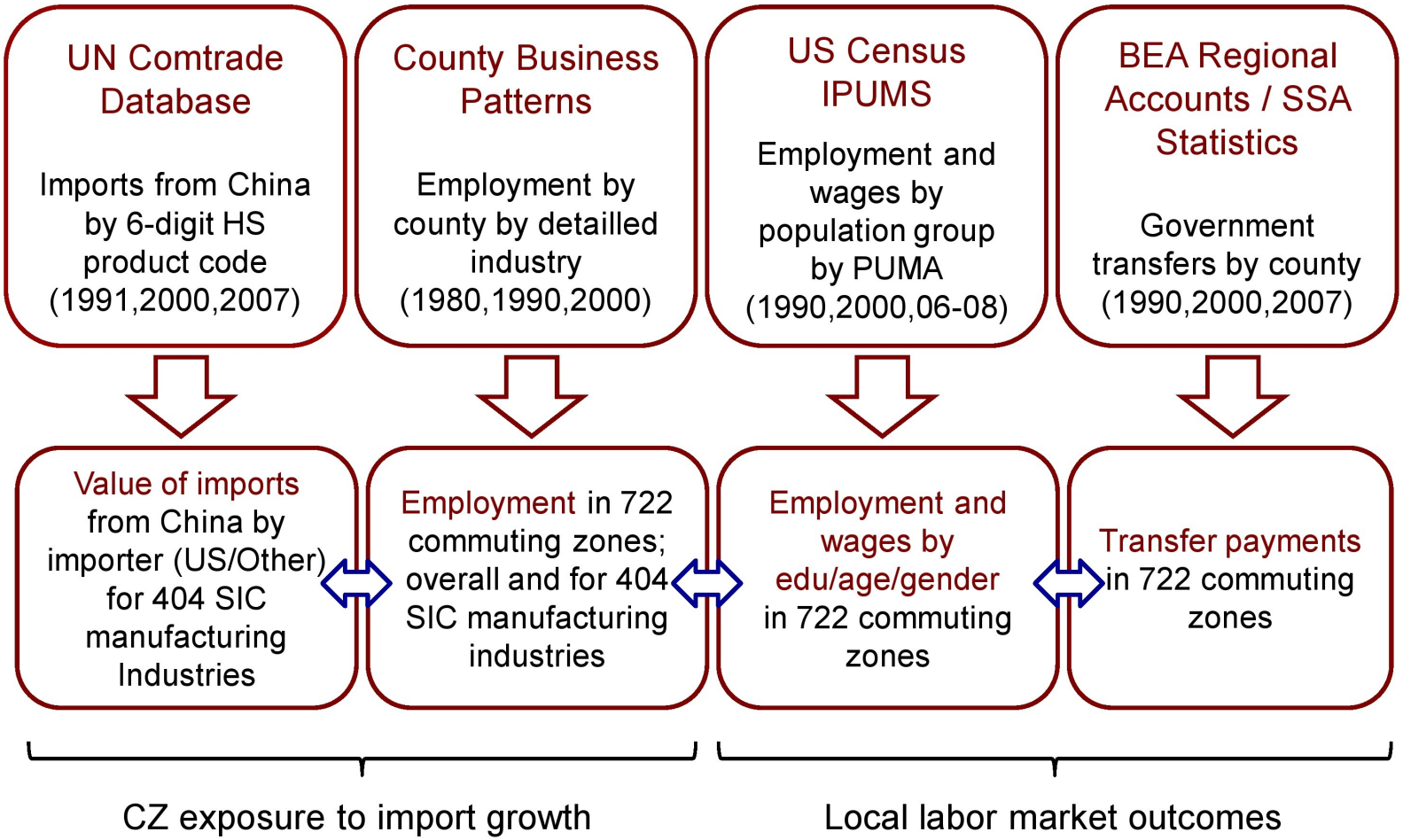
- **Concern:**
  - U.S imports from China affected by U.S. demand shocks as well as China's growing productivity and falling trade costs
- **Approach:**
  - Instrument for ΔIPW_{it} using other high-income countries' imports from China (and lagged CZ employment)

$$\Delta IPW_{oit} = -\sum_j \frac{E_{uijt-10}}{E_{ujt-10}} \left[\frac{\Delta M_{ocjt}}{E_{it-10}} \right]$$

- **Rationale: China's export growth driven by...**
  - Rural to urban migration (over 150m migrants moved to cities)
  - Opening to foreign investments, technology, imported inputs
  - WTO accession in 2001 (reduction in trade barriers)
  - China's latent comparative advantage $\rightarrow$ Similar export bundles going to high income markets

Instrument also deals with measurement error

Data sources: Time periods 1990-2000, 2000-2007



Chinese import exposure by CZ

Δ China imports per worker (in 1,000s of US$) across CZs

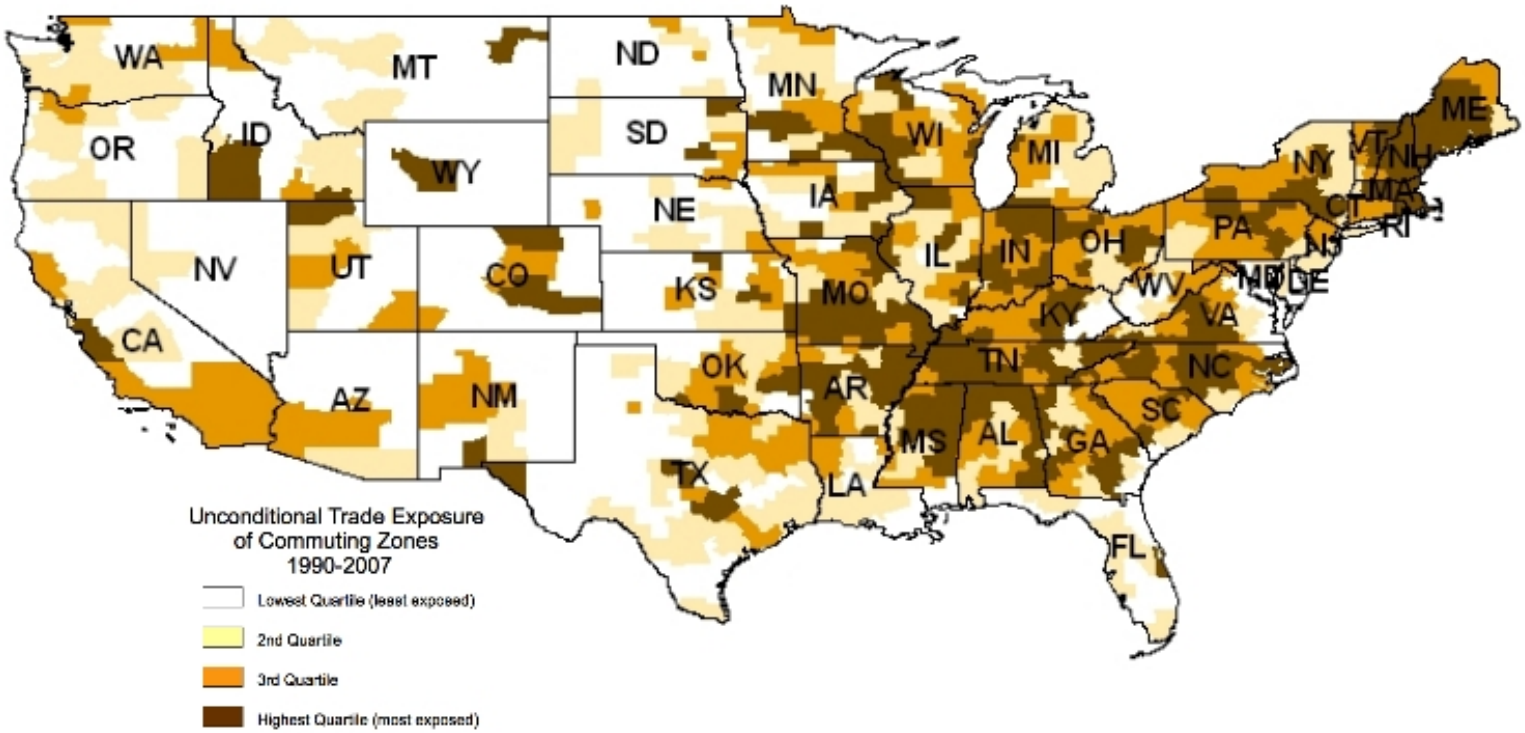
Appendix Table 1. Descriptive Statistics for Growth of Imports Exposure per Worker across C'Zones

I. 1990-2000		II. 2000-2007	
A. Percentiles			
90th percentile	2.05	90th percentile	4.30
75th percentile	1.32	75th percentile	3.11
50th percentile	0.89	50th percentile	2.11
25th percentile	0.62	25th percentile	1.60
10th percentile	0.38	10th percentile	1.03

Over all CZ's:

- 75/25 pctile Δ: $1,510 in 2000-2007 (over 10 yrs)
- 75/25 pctile Δ: $700 in 1990-2000
- Average per decade over 1990-2007: $1,105

Import exposure 1990-2007 (not cond'l on manufacturing)



Among 50 Largest Commuting Zones

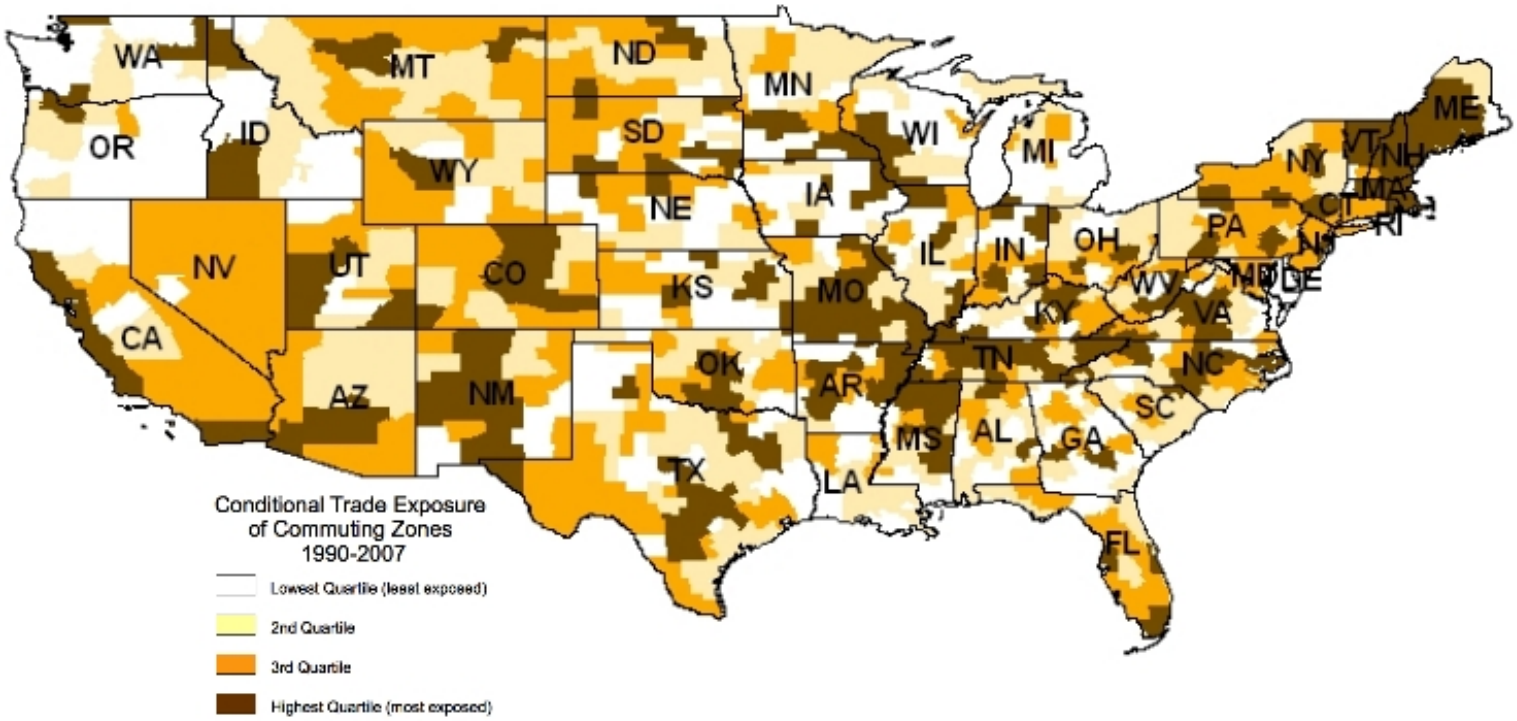
(A) Largest Increase in Exposure

1. San Jose, CA
2. Raleigh, NC
3. Providence, RI

(B) Smallest Increase in Exposure

1. New Orleans, LA
2. Washington, DC
3. Virginia Beach, VA

Import exposure 1990-07 (cond'l on manufacturing emp)



Among 50 Largest Commuting Zones

(A) Largest Increase in Exposure

1. San Jose, CA
2. Raleigh, NC
3. Providence, RI

(B) Smallest Increase in Exposure

1. Detroit, MI
2. Grand Rapids, MI
3. Seattle, WA

Estimation

- **Regression model:**

$$\Delta y_{it} = \gamma_t + \beta_0 \Delta IPW_{uit} + X_{it}' \beta_1 + e_{it}$$

where:

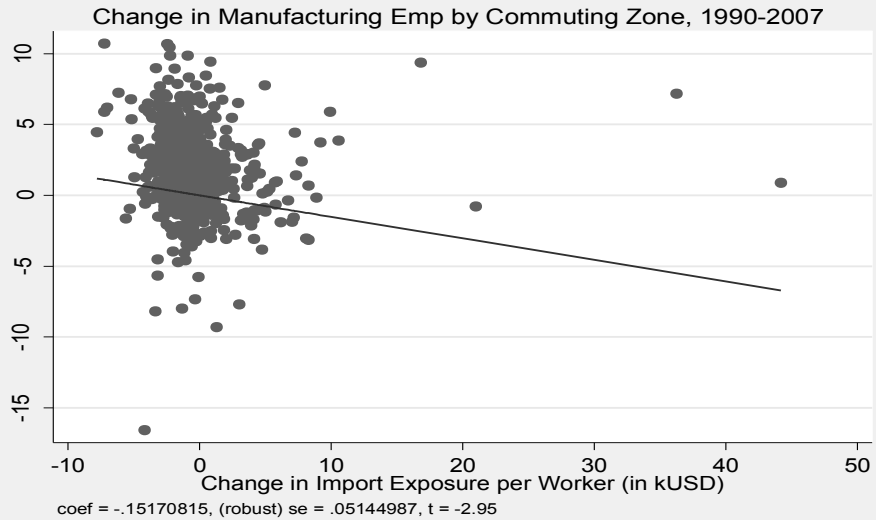
  - Δy_{it} is 10-year equivalent change of emp, pop, wages, or transfers
  - γ_t is a period effect (time periods 1990–2000, 2000–2007)
  - ΔIPW_{uit} is import exposure
  - X_{it} contains start of period CZ manufacturing employment share and CZ demographics
  - Observations weighted by CZ population; SEs clustered by state

- **Instrumental variable:**

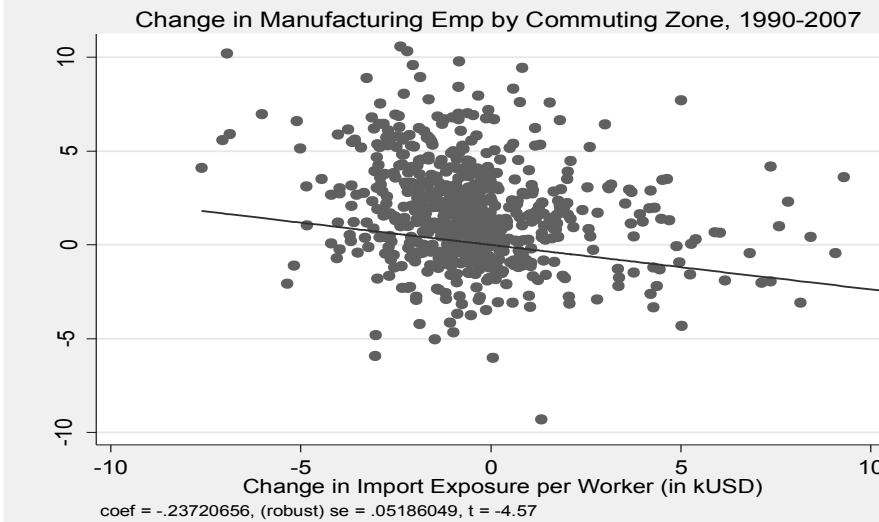
  - ΔIPW_{uit} instrumented by ΔIPW_{oit}

Effect of import exposure on mfg emp/pop: OLS

Panel A: OLS Regression, Full Sample



Panel B: OLS Regression, Trimmed Sample



- Increase in Chinese import exposure related to decline in working age pop in manufacturing
  - Outliers in $\Delta IPW_{ui\tau}$ (small CZ's) appear to attenuate estimates
  - 2nd graph drops 15 CZs $>$ 5 SDs from median $\Delta IPW_{ui\tau}$ ($<$ 1% of pop)

IV strategy: Exogenous variation in Chinese import shocks

- **Concern:**
  - U.S imports from China affected by U.S. demand shocks as well as China's growing productivity and falling trade costs
- **Approach:**
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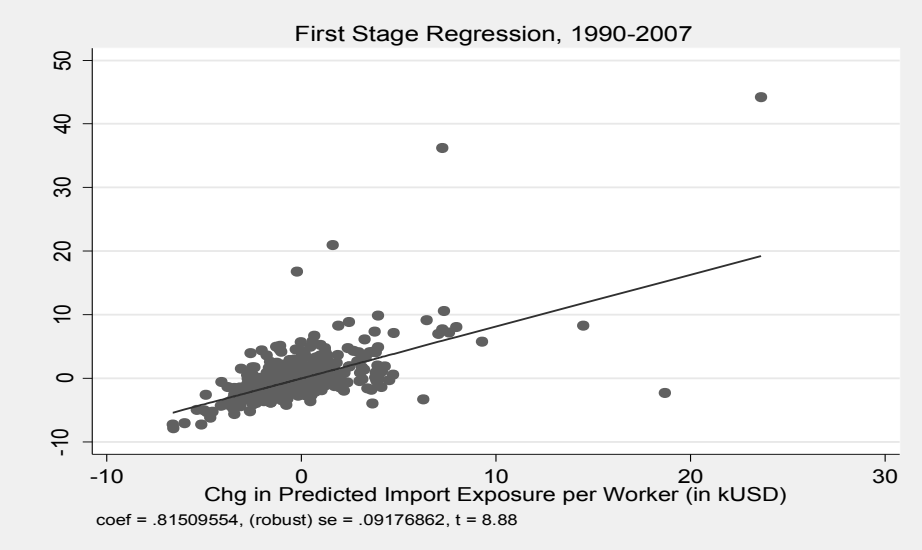
$$\Delta IPW_{oit} = -\sum_j \frac{E_{uijt-10}}{E_{ujt-10}} \left[\frac{\Delta M_{ocjt}}{E_{it-10}} \right]$$

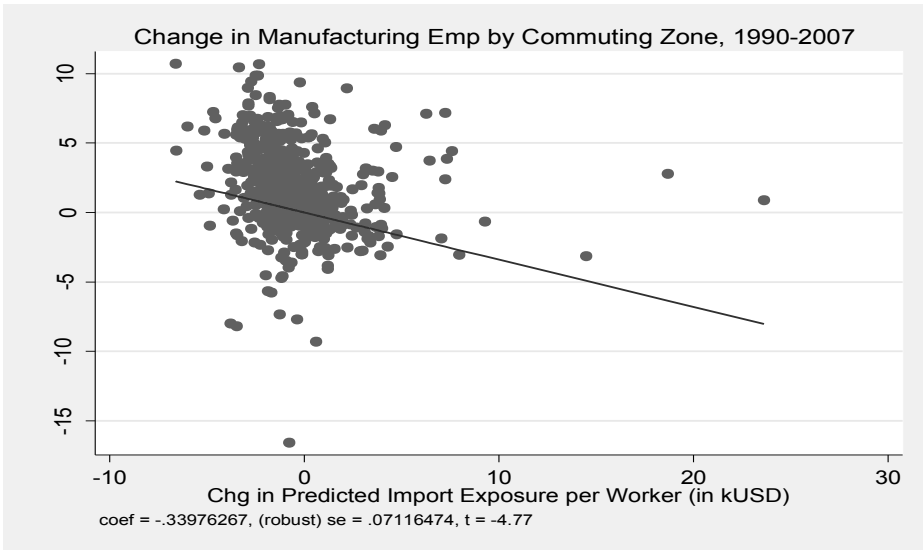
- **Rationale: China's export growth driven by...**
  - Rural to urban migration (over 150m migrants moved to cities)
  - Opening to foreign investments, technology, imported inputs
  - WTO accession in 2001 (reduction in trade barriers)
  - China's latent comparative advantage $\rightarrow$ Similar export bundles going to high income markets
  - Instrument also deals with measurement error

2SLS first stage and reduced form estimates

Panel A: 2SLS 1st Stage Regression, Full Sample



Panel B: OLS Reduced Form Regression, Full Sample



Note: Plots control for CZ's initial manufacturing employment share

2SLS estimates for 1990–2007 and prior decades

Table 2. Imports from China and Change of Manufacturing Employment in Commuting Zones, 1970-2007: 2SLS Estimates.
Dependent Variable: 10 x Annual Change in Manufacturing Emp/Working Age Pop (in %pts)

	I. 1990-2007			II. 1970-1990 (Pre-Exposure)		
	1990-2000	2000-2007	1990-2007	1970-1980	1980-1990	1970-1990
	(1)	(2)	(3)	(4)	(5)	(6)
(Δ Current Period Imports from China to US)/Worker	-0.89 **	-0.72 **	-0.75 **			
	(0.18)	(0.06)	(0.07)			
(Δ Future Period Imports from China to US)/Worker				0.43 **	-0.13	0.15
				(0.15)	(0.13)	(0.09)

Notes: N=722, except N=1444 in stacked first difference models of columns 3 and 6. The variable 'future period imports' is defined as the average of the growth of a CZ's import exposure during the periods 1990-2000 and 2000-2007. All regressions include a constant and the models in columns 3 and 6 include a time dummy. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

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Measuring Routine-Task Intensive Occupations

- Rank occs o by ratio of Routine to Non-Routine task input in 1980:

$$RTI_o = \ln\left(T^R_{o,1980}\right) - \left[\ln\left(T^M_{o,1980}\right) + \ln\left(T^A_{o,1980}\right)\right]$$

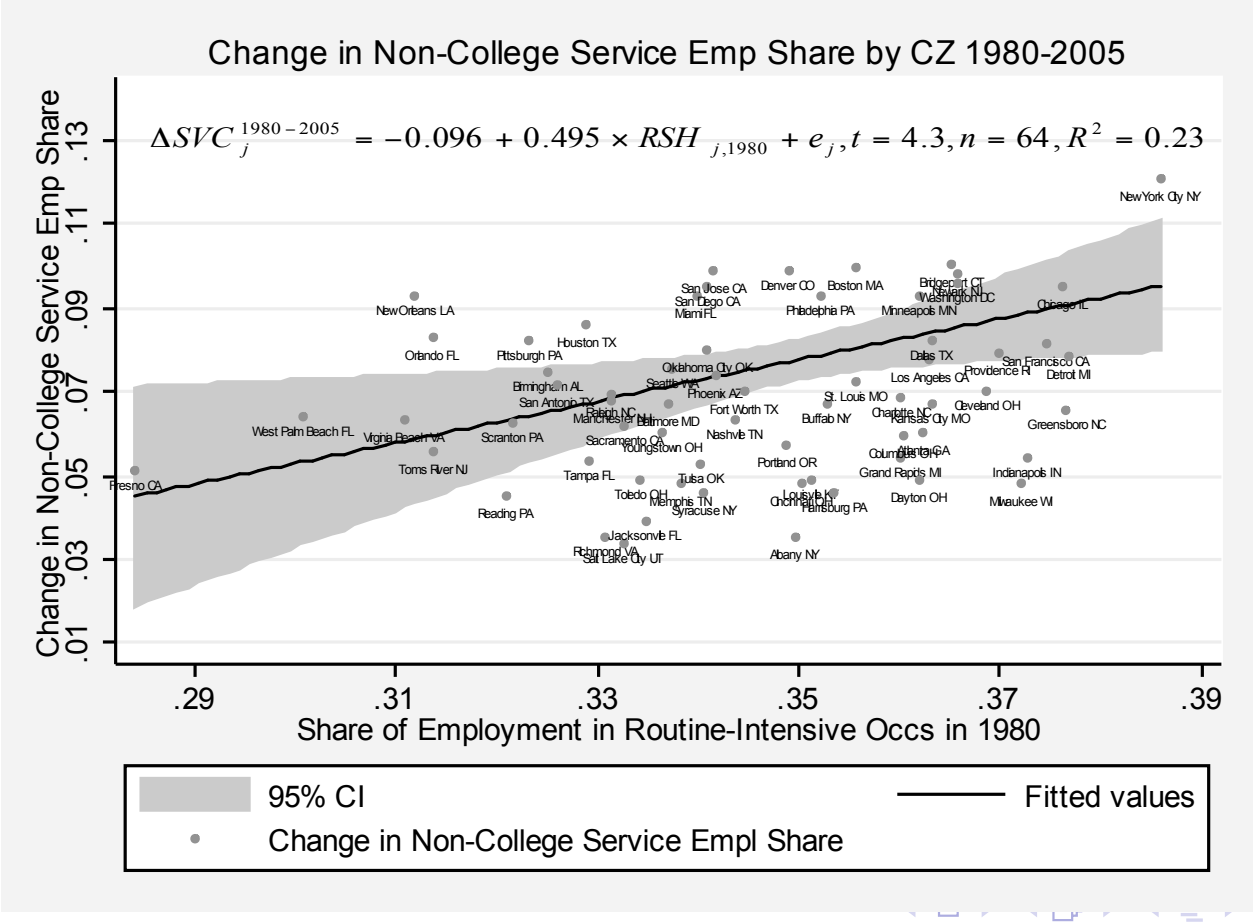
Measuring Routine-Task Intensive Occupations

A. Occupations with Highest RTI Scores	B. Low-Skill Occupations with Lowest RTI Scores	C. High-Skill Occupations with Lowest RTI Scores
1 Butchers & meat cutters	1 Bus drivers	1 Fire fighting, prevention & inspection
2 Secretaries & stenographers	2 Taxi cab drivers & chauffeurs	2 Police & detectives, public service
3 Payroll & timekeeping clerks	3 Waiters & waitresses*	3 Primary school teachers
4 Bank tellers	4 Truck, delivery, & tractor drivers	4 Managers of properties & real estate
5 File clerks	5 Door-to-door/street sales, news vendors	5 Secondary school teachers
6 Cashiers	6 Carpenters	6 Electrical engineers
7 Typists	7 Telecom & line installers & repairers	7 Physicians
8 Pharmacists	8 Housekeepers, maids, butlers & cleaners*	8 Computer systems analysts & scientists
9 Bookkeepers, accounding clerks	9 Health & nursing aides*	9 Civil engineers
10 Postal clerks, except mail carriers	10 Electricians	10 Industrial engineers

Measuring Routine-Task Intensive CZs

- Calculate for each CZ i a routine employment share measure, RSH_{jt}:

$$RSH_{it} = \left(\sum_{o=1}^{O} L_{oit} \cdot 1\left[RTI_o > RTI^{P66}\right]\right)\left(\sum_{o=1}^{O} L_{oit}\right)^{-1}$$



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Estimation

Regression model:

$$\Delta y_{it} = \gamma_t + \beta_0 \Delta IPW_{uit} + \beta_1 RSH_{it} + X'_{it}\beta_2 + e_{it}$$

where:

- Equation augmented with start-of-period Routine-Share *RSH* variable
- ΔIPW_{uit} is import exposure as before, instrumented by ΔIPW_{oit}
- Observations weighted by CZ population; SEs clustered by state

2SLS: Stacked first differences, 1990–2007

Table 3. Imports from China and Change of Manufacturing Employment in CZs 1990-2007
Dependent Var: 10 x Annual Change in Manufacturing Emp/Working Age Pop (in %pts)

	(1)		(2)		(3)		(4)		(5)		(6)	
(Δ Imports from China to US)/Worker	-0.746	**	-0.610	**	-0.538	**	-0.508	**	-0.562	**	-0.596	**
	(0.068)		(0.094)		(0.091)		(0.081)		(0.096)		(0.099)	
Percentage of employment in manufacturing$_{-1}$			-0.035		-0.052	**	-0.061	**	-0.056	**	-0.040	**
			(0.022)		(0.020)		(0.017)		(0.016)		(0.013)	
Percentage of college-educated population$_{-1}$							-0.008				0.013	
							(0.016)				(0.012)	
Percentage of foreign-born population$_{-1}$							-0.007				0.030	**
							(0.008)				(0.011)	
Percentage of employment among women$_{-1}$							-0.054	*			-0.006	
							(0.025)				(0.024)	
Percentage of employment in routine occupations$_{-1}$									-0.230	**	-0.245	**
									(0.063)		(0.064)	
Average offshorability index of occupations$_{-1}$									0.244		-0.059	
									(0.252)		(0.237)	
Census division dummies	No		No		Yes		Yes		Yes		Yes	
R^2	0.54		0.57		0.58		0.58		0.58		0.58	

Notes: N=1444 (722 commuting zones x 2 time periods). Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ p ≤ 0.10, * p ≤ 0.05, ** p ≤ 0.01.

Other Sensitivity Tests (many)

1. **Expanding measure of imports (below)**
   - Imports from China plus other low income countries
   - Imports from China plus Mexico and DR/CAFTA
2. **Excluding specific industries (not shown)**
   - Drop computer industry
   - Drop apparel, textiles, and footwear
   - Drop industries used as inputs in construction

Magnitudes: Impact on manufacturing employment

- Δ U.S. manufacturing Emp/Pop fell by 33% between 1990 and 2007:
  - 1990 - 2000: -2.07%. 2000 - 2007: -2.73%
- Δ Chinese imports per U.S. worker:
  - 1990 - 2000: $1,140
  - 2000 - 2007: $2,630
  - Estimate 48% of Δ Chinese imports driven by *supply shock*
- Δ Chinese imports → ΔU.S. manufacturing Emp/Pop (pct points):
  - 1990 - 2000: -0.33%
  - 2000 - 2007: -0.75%
- **Pct of Δ U.S. Manuf Emp/Pop caused by ΔChina exposure:**
  - 1990 - 2000: 16%
  - 2000 - 2007: 28%
  - 1990 - 2007: 23%

Alternative to 2SLS: Gravity residual approach

- **Gravity equation:**

$$\ln(X_{cnj}) - \ln(X_{unj}) = \ln(z_{cj}) - \ln(z_{uj}) - \theta[\ln(\tau_{cnj}) - \ln(\tau_{unj})$$

- **OLS counterpart:**

$$\ln(X_{cnjt}) - \ln(X_{unjt}) = \alpha_j + \alpha_n + \epsilon_{njt}$$

where:

- α_j is an industry fixed effect
- α_n is an importer fixed effect
- $\epsilon_{njt} \approx \left[\ln\left(\frac{z_{cjt}}{z_{ujt}}\right) - \alpha_j\right] + \left[-\theta \ln\left(\frac{\tau_{cnjt}}{\tau_{unjt}}\right) - \alpha_n\right]$
- $[\ln\left(\frac{z_{cjt}}{z_{ujt}}\right) - \alpha_j]$ is China's relative TFP in industry j year t
- $[-\theta \ln\left(\frac{\tau_{cnjt}}{\tau_{unjt}}\right) - \alpha_n]$ is China's rel. trade cost for ind j, country n, yr t

Alternative to 2SLS: Gravity residual approach

Applying gravity residual to create CZ import exposure measure:

- CZ import exposure measure same as instrument ΔIPW_{oit}

$$\Delta IPW_{git} = \sum_j \frac{E_{ijt-1}}{E_{ujt-1}} \cdot \frac{\Delta \bar{\epsilon}_{jt} M_{ucjt-1}}{E_{it-1}}$$

- **Except** replaces ΔM_{ocjt} with $\bar{\epsilon}_{jt} M_{ucjt-1}$ in exposure measure
- Hence gravity-measure, import exposure measure use same units
- These estimates come later (in the 'net imports' section)

Imports + Exports: 2SLS and Gravity Approaches

Table 10a. Adding Exposure to Indirect Import Competition, 1990-2007: 2SLS and OLS Estimates. Dependent Variables: 10-Year Equivalent Changes of Indicated Variables

	I. Employment/Pop		II. Log Wages		III. Transfers, Wage Inc	
	Mfg (1)	Non-Mfg (2)	Mfg (3)	Non-Mfg (4)	Log Transfers (5)	Avg Log HH Wage Inc (6)
Baseline Results 2SLS: Exposure to Imports from China (using Chn-OTH Trade)						
(Δ Imports from China to US)/Worker	-0.60 **	-0.18	0.15	-0.76 **	1.01 **	-2.14 **
	(0.10)	(0.14)	(0.48)	(0.26)	(0.33)	(0.59)
2SLS: Exposure to Domestic *and* Intl Imports from China (using Chn-OTH Trade)						
(Δ Domestic + Intnl Exposure to China Imports)/ Worker	-0.42 **	-0.10	0.11	-0.47 **	0.87 **	-1.75 **
	(0.05)	(0.10)	(0.33)	(0.18)	(0.22)	(0.43)
Reduced Form OLS: Change in China-US Productivity Differential						
(Δ Domestic + Intnl Exposure to China Imports)/ Worker	-0.29 **	-0.03	0.04	-0.26 ~	0.53 **	-0.93 **
	(0.04)	(0.08)	(0.28)	(0.15)	(0.14)	(0.28)

Notes: N=1444 (722 commuting zones x 2 time periods). Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

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Migration responses?

- **Does decline in manufacturing employment cause fall in working-age pop?**

$$\Delta \ln Pop_{i\tau} = \gamma_\tau + \beta_1 \Delta IPW_{ui\tau} + X'_{it}\beta_2 + e_{c\tau}$$

- Local effects of import shocks may partly diffuse through migration between CZs
- Literature suggests that migration responses are sluggish (Blanchard and Katz, 1991; Bound and Holzer, 2000; Notowidigdo, 2010)

Effect of import exposure on CZ working age pop

Table 4. Imports from China and Change of Working Age Population within Commuting Zones, 1990-2007
Dependent Variables: 10-Year Equivalent Log Changes in Headcounts (in log pts)

	I. By Education Level			II. By Age Group		
	All	College	Non-College	Age 16-34	Age 35-49	Age 50-64
	(1)	(2)	(3)	(4)	(5)	(6)
A. No Census Division Dummies or Other Controls						
(Δ Imports from China to US)/Worker	-1.031 *	-0.360	-1.097 *	-1.299	-0.615	-1.127 **
	(0.503)	(0.660)	(0.488)	(0.826)	(0.572)	(0.422)
R^2	.	0.03	0.00	0.17	0.59	0.22
B. Controlling for Census Division Dummies						
(Δ Imports from China to US)/Worker	-0.355	0.147	-0.240	-0.408	-0.045	-0.549
	(0.513)	(0.619)	(0.519)	(0.953)	(0.474)	(0.450)
R^2	0.36	0.29	0.45	0.42	0.68	0.46
C. Full Controls						
(Δ Imports from China to US)/Worker	-0.050	-0.026	-0.047	-0.138	0.367	-0.138
	(0.746)	(0.685)	(0.823)	(1.190)	(0.560)	(0.651)
R^2	0.42	0.35	0.52	0.44	0.75	0.60

Notes: N=1444 (722 commuting zones x 2 time periods). Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Comparing Impacts on Pop, Emp, Unemp, NILF

Imports from China and Change of Working Age Population, Employment, Unemployment, and Nonemployment in C'Zones, 1990-2007: 2SLS Estimates. Dependent Variables: 10-Year Equiv. Log Changes in Headcounts (in log pts)

	Log Changes in Population, Emp, Unemp and NILF									
	Population (1)		Emp in Mfg (2)		Emp in Non-Mfg (3)	Unemployed (4)		NILF (5)		
A. No Census Division Dummies or Other Controls										
(Δ Imports from China to US)/Worker	-1.03	*	-3.90	**	-0.74	2.61	*	0.80		
	(0.50)		(0.69)		(0.52)	(1.11)		(0.55)		
B. Controlling for Census Division Dummies										
(Δ Imports from China to US)/Worker	-0.35		-3.22	**	-0.11	3.49	**	1.48	*	
	(0.51)		(0.70)		(0.50)	(0.83)		(0.63)		
C. Full Controls										
(Δ Imports from China to US)/Worker	-0.05		-4.23	**	-0.27	4.92	**	2.06	~	
	(0.75)		(1.05)		(0.65)	(1.13)		(1.08)		

Notes: N=1444 (722 commuting zones x 2 time periods). ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

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    4. Technology, trade and task structure
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Unpacking Employment Impacts

Changes in Employment by Occupation

- **Unpack total ΔEmp/Pop effects into occupation effects (ΔOcc-Emp/Pop):**

$$\Delta y_{oit} = \gamma_t + \beta_0 \Delta IPW_{uit} + \beta_1 RSH_{it} + X_{it}^{'} \beta_2 + e_{oit}$$

1. Managerial + Professional + Technical
2. Clerical + Retail Sales
3. Production Occupations
4. Transportation + Craft Occupations + Mechanics
5. Farming + Mining
6. Service Occupations (e.g., cleaning, food service, personal care, security)

Tech, Trade and Occs: All Sectors

Decomposition of Change in Employment Rate by Sector and Occupation Group, 1990-2007: 2SLS Estimates. Dep Var: 10-Year Equiv. Changes in Share of Working Age Population Employed in Sector-Occupation Cell (in %pts)

	All Occs (1)		Mgmt/Prof Tech (2)		Clerical/ Retail Sales (3)		Production Occs (4)		Trans/ Craft/Mech (5)		Farm/ Mining (6)		Service Occs (7)
						A. All Sectors							
(Δ Imports from China to US)/Worker	-0.774	**	-0.160	*	-0.090	~	-0.317	**	-0.236	**	0.012		0.016
	(0.176)		(0.078)		(0.049)		(0.045)		(0.052)		(0.015)		(0.047)
Share of Emp in Routine Occs $_{-1}$	-0.208	*	0.028		-0.068	~	-0.161	**	-0.081	**	0.070	**	0.004
	(0.089)		(0.025)		(0.037)		(0.037)		(0.022)		(0.020)		(0.018)

Notes: N=1444 (722 commuting zones x 2 time periods). All regressions control for the start of period levels of share of employment in manufacturing, share of population that is college educated and foreign born, female employment rate, share employment in routine occupations, offshorability index score of occupations, and Census division dummies. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Tech, Trade and Occs: Manufacutring

Decomposition of Change in Employment Rate by Sector and Occupation Group, 1990-2007: 2SLS Estimates. Dep Var: 10-Year Equiv. Changes in Share of Working Age Population Employed in Sector-Occupation Cell (in %pts)

	All Occs (1)		Mgmt/Prof Tech (2)		Clerical/ Retail Sales (3)		Production Occs (4)		Trans/ Craft/Mech (5)		Farm/ Mining (6)		Service Occs (7)	
						B. Manufacturing Sector								
(Δ Imports from China to US)/Worker	-0.596	**	-0.198	**	-0.063	**	-0.297	**	-0.040	**	0.000		0.001	
	(0.099)		(0.065)		(0.014)		(0.046)		(0.014)		(0.003)		(0.002)	
Share of Emp in Routine Occs $_{-1}$	-0.245	**	0.003		-0.035	**	-0.166	**	-0.037	**	-0.003	**	-0.006	**
	(0.064)		(0.015)		(0.011)		(0.036)		(0.009)		(0.001)		(0.002)	

Notes: N=1444 (722 commuting zones x 2 time periods). All regressions control for the start of period levels of share of employment in manufacturing, share of population that is college educated and foreign born, female employment rate, share employment in routine occupations, offshorability index score of occupations, and Census division dummies. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Tech, Trade and Occs: Non-Manufacturing

Decomposition of Change in Employment Rate by Sector and Occupation Group, 1990-2007: 2SLS Estimates. Dep Var: 10-Year Equiv. Changes in Share of Working Age Population Employed in Sector-Occupation Cell (in %pts)

	All Occs (1)	Mgmt/Prof Tech (2)	Clerical/ Retail Sales (3)	Production Occs (4)	Trans/ Craft/Mech (5)	Farm/ Mining (6)	Service Occs (7)
				C. Non-Manufacturing Sector			
(Δ Imports from China to US)/Worker	-0.178	0.038	-0.027	-0.020 ~	-0.196 **	0.012	0.014
	(0.137)	(0.069)	(0.043)	(0.012)	(0.046)	(0.016)	(0.048)
Share of Emp in Routine Occs $_{-1}$	0.037	0.025	-0.033	0.005	-0.043 *	0.073 **	0.010
	(0.058)	(0.022)	(0.031)	(0.006)	(0.017)	(0.020)	(0.018)

Notes: N=1444 (722 commuting zones x 2 time periods). All regressions control for the start of period levels of share of employment in manufacturing, share of population that is college educated and foreign born, female employment rate, share employment in routine occupations, offshorability index score of occupations, and Census division dummies. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

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Tech, Trade and Tasks

All Sectors and Manufacturing Only

Effect of Exposure to Chinese Imports, Routinization, and Offshorability on Occupational Tasks, 1990-2007: 2SLS Estimates.
Dep Var: 10-Year Equiv. Changes in Average Task Values

	I. All Sectors			II. Manufacturing Sector		
	Abstract (1)	Routine (2)	Manual (3)	Abstract (4)	Routine (5)	Manual (6)
	A. Descriptives: Average Value of Standardized Task Variables, 1990					
[Mean and S.D. of Variable]	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	-1.141 (1.975)	5.876 (1.415)	-0.685 (1.339)
	B. Regression Analysis: Change in Tasks, 1990-2007					
(Δ Imports from China to US)/Worker	0.696 * (0.353)	-2.000 ** (0.321)	0.145 (0.154)	0.334 (1.417)	-0.513 (0.884)	0.691 (0.656)
Share of Emp in Routine $Occs_{-1}$	1.157 ** (0.198)	-1.703 ** (0.197)	0.308 ** (0.101)	-0.531 (0.635)	-0.401 (0.268)	0.376 (0.291)

Notes: N=1444 (722 commuting zones x 2 time periods). All task values are standardized to a cross-commuting zone mean of zero and standard deviation of 1 in 1990. All regressions control for the start of period levels of share of employment in manufacturing, share of population that is college educated and foreign born, female employment rate, offshorability index of occupations, and Census division dummies. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

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Conclusions

Both rising import competition, technological change have large effects on local labor markets:

- Reduced manufacturing employment
- Gains not offset by non-manufacturing employment
- Migration responses weak $\rightarrow$ Regional transmission slow

Key surprises:

1. Almost no correlation between routine task-intensity of local labor market and trade exposure
2. Both technology and trade shocks contribute to decline in routine task intensity
   - Technology channel more precise, concentrated
3. Evidence that employment reallocation incomplete
   - Over ten years, job losses offset gains, total emp/pop falls