The Effect of Import Competition on Employment in Canada: Evidence from the 'China Shock'

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Overview of today's presentation

- Research question: How has the rise of China as an export superpower affected Canadian employment?
- Agenda for presentation:
  1. Set the stage: Empirical context and existing literature
  2. Measurement, identification strategy, and data
  3. Three sets of estimates
     - ★ Regression specification
     - ★ Results
  4. Discussion

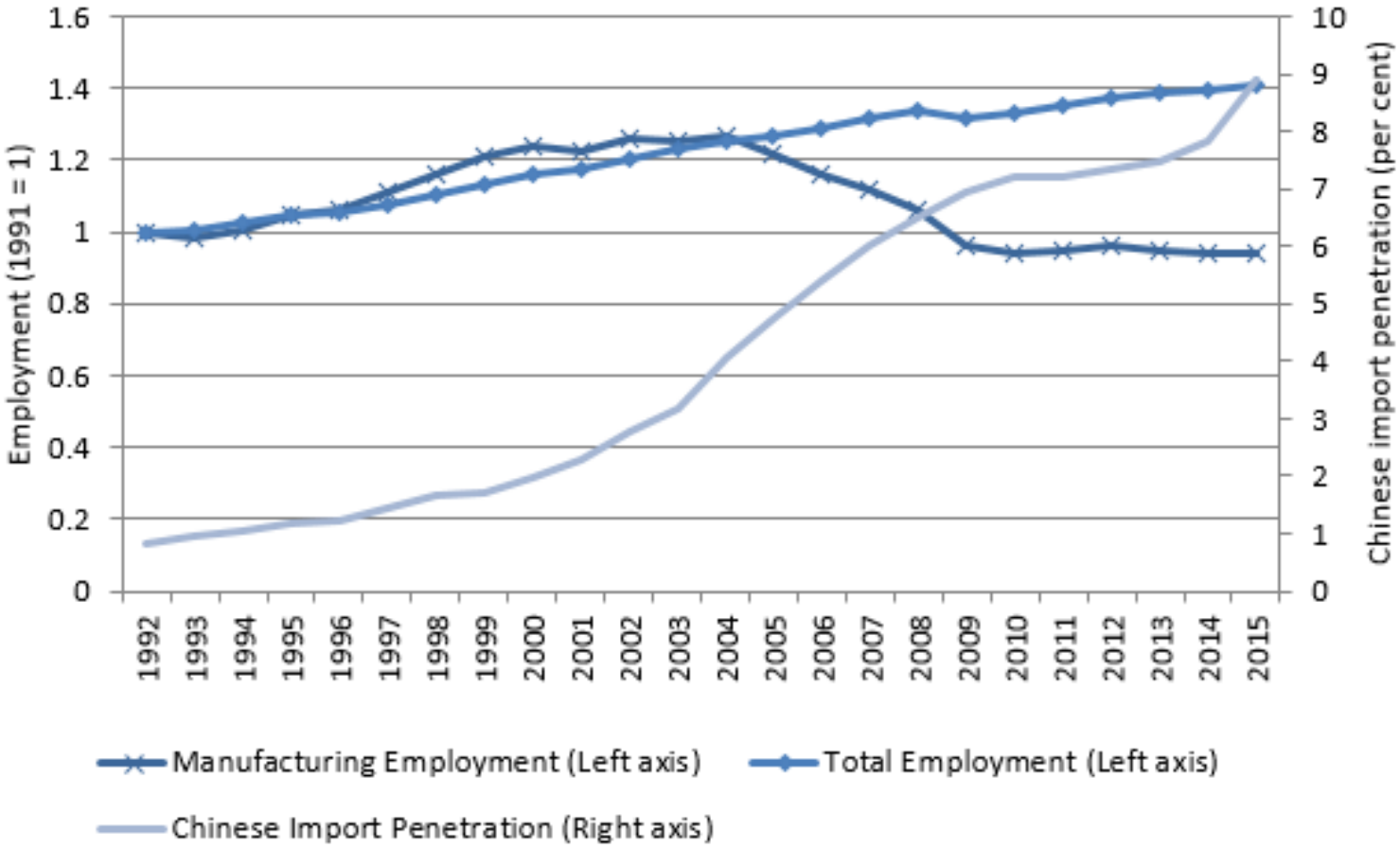
How does import competition affect labour markets?

- Theory says import competition *could* harm unskilled workers and raise earnings inequality in advanced economies. But *does* it?
- Literature through the early 2000s said "No"
  - Most trade is between rich countries with similar endowments
  - High labour market flexibility; displaced workers can easily relocate
  - Skill-biased technological change is a more important factor
- More recent literature says "Maybe yes"
  - More trade with developing economies – especially China
  - Labour market frictions may inhibit reallocation across industries or regions
  - Key empirical evidence for the United States: the 'China Shock' literature
    - ★ Autor *et al.* (2013a; 2013b; 2014; 2015; 2016)
    - ★ Acemoglu *et al.* (2016)

Recent evidence on Canada is thin

- Old literature on Canada-US trade liberalization
  - Gaston and Trefler (1997); Baldwin and Rafiquzzaman (1999); Beaulieu (2000); Lemieux (2004); Trefler (2004); Townsend (2007)
  - Basic findings:
    - ★ Employment losses in manufacturing industries that lost tariff protection
    - ★ Losses concentrated among production workers (i.e. unskilled)
    - ★ Mixed evidence on impact on wages
- Not much recent evidence on Canada's trade with developing economies
  - In Mincer-type wage equations, import penetration from developing economies reduced relative wages of unskilled workers (Breau and Rigby, 2010)
  - In CGE model, increased foreign competition reduces manufacturing employment and raises low-income rates in the short run; in the long run, enhanced efficiency and capital accumulation offset these effects (Annabi *et al.*, 2013)

Canadian employment during the rise of China



Empirical Approach

- Exposure to rising Chinese import competition varies across industries and across localities
- Exploit this variation to develop three estimates of the impact on employment:
  1. **Direct effect** in manufacturing industries
  2. Effects arising from **input-output linkages** across industries
  3. Effect in **local labour market**s, including net effect of labour reallocation and demand spillovers

Basic building block

- Change in import exposure at the industry level

$$\Delta IE_{j,t} = \frac{\Delta M^{CC}_{j,t}}{Y_{j,0} + M_{j,0} - X_{j,0}}$$

  - Change in Canada's real imports from China in industry j over time period t
  - Normalized by real domestic absorption in initial year (1992)
  - Measured for manufacturing industries
  - This is a measure of the change in competition with China over the domestic Canadian market

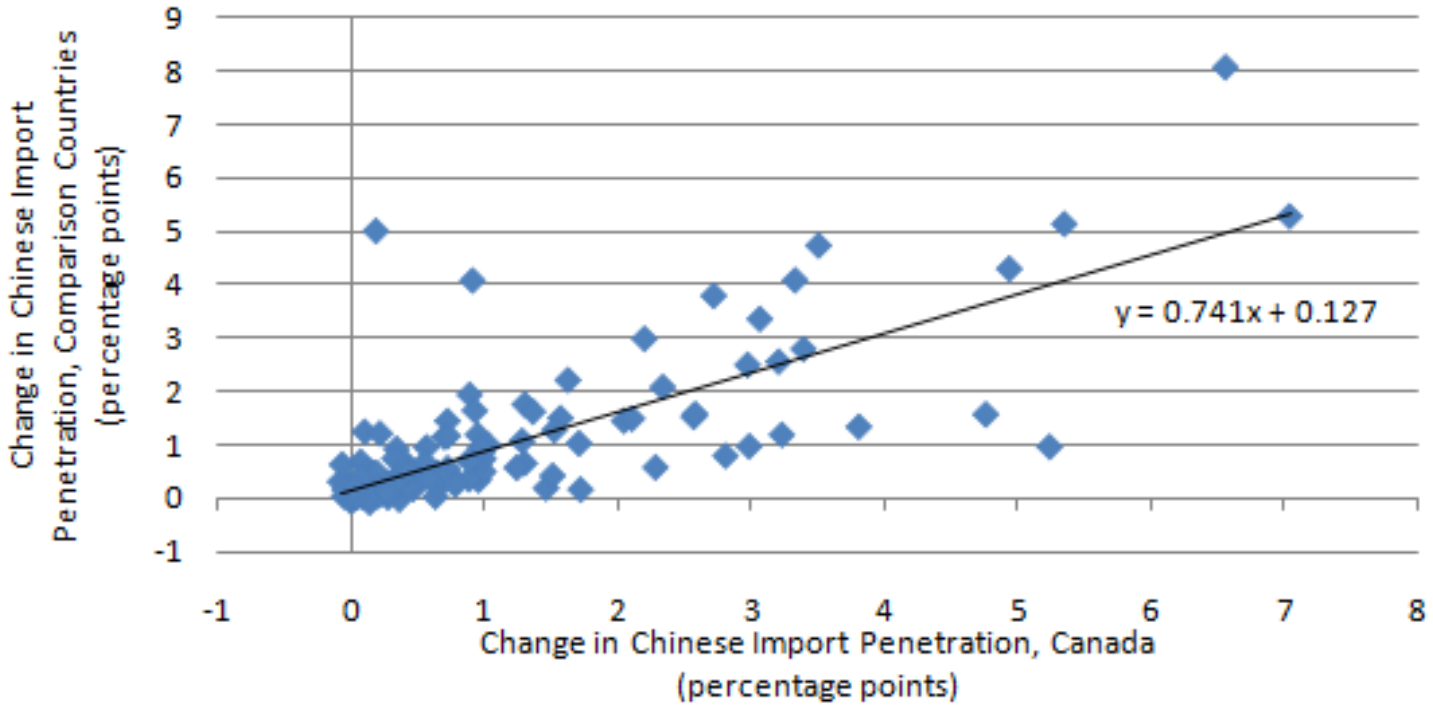
IV strategy: exogenous variation in Chinese import growth

- Concern:
  - Imports from China may be influenced by both Canadian import demand shocks and Chinese export supply shocks
- Solution:
  - Instrument for Canadian imports using other advanced economies' imports from China,

$$\Delta IEO_{j,t} = \frac{\Delta M_{j,t}^{oc}}{Y_{j,0}+M_{j,0}-X_{j,0}}$$

- Rationale:
  - China's export growth has been driven by factors internal to China
    - ★ Urbanization, WTO accession (2001), opening to foreign investment and technology
  - Common component of Chinese import growth across advanced economies plausibly captures this positive shock to Chinese export supply

Chinese import exposure and its instrument, 1991-2001 and 2001-2011



Data

- Trade data: imports from China by 4-digit NAICS manufacturing industry
  - Canada: Trade Data Online (TDO), ISED
  - Instrument: UN Comtrade database
    - ★ Raw data by 6-digit HS commodity
    - ★ Map to 4-digit NAICS (Pierce and Schott, 2012)
- Employment data:
  - Industry-level: employment by 4-digit NAICS industry
  - Local level: employment 4-digit NAICS industry by CMA/CA
  - Sources: 1991 and 2001 censuses, 2011 NHS
    - ★ For 1991: Used 2001 census to build SIC-to-NAICS mapping by CMA/CA
- Initial domestic absorption: Monthly Survey of Manufacturing and TDO
- Input-output table for 1992, L-level aggregation (detailed)

Estimating industry-level direct effect

- Regression specification:

$$\Delta L_{j,t} = \alpha_t + \beta \Delta IE_{j,t} + e_{j,t}$$

  - $\Delta L_{j,t}$ =annual employment growth in industry j over period t
  - α_t =period effect (1991-2001 and 2001-2011)
  - $\Delta IE_{j,t}$ =change in import exposure; instrumented by $\Delta IEO_{j,t}$
  - Observations weighted by initial industry employment; SEs clustered by 3-digit NAICS industry

- Given estimate $\hat{\beta}$, count total employment effect:

$$L_t - L_t^{cf} = \sum_j L_{j,t} \left(1 - e^{-\hat{\beta}\widetilde{\Delta IE_{j,t}}}\right)$$

  - $L_t - L_t^{cf}$ = difference between actual and counterfactual employment at end of time t
  - $\widetilde{\Delta IE_{j,t}} = 0.57 \times \Delta IE_{j,t}$ (first-stage partial R-squared = 0.57)

Regression estimates

Effect of Import Exposure on Employment in Canadian Manufacturing Industries: OLS and 2SLS Estimates

	Stacked Differences			Separated by Sub-period			
	1991-2001 and 2001-2011			1991-2001	1991-2001	2001-2011	2001-2011
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Annual Δ in Chinese import exposure	--	-0.82* (0.48)	-1.36** (0.68)	-0.01 (0.41)	-0.74 (0.54)	-1.05* (0.58)	-1.48** (0.75)
𝟙{1991-2001}	0.91** (0.43)	1.23*** (0.42)	1.43*** (0.47)	--	--	--	--
𝟙{2001-2011}	-3.44*** (0.71)	-2.70*** (0.57)	-2.22*** (0.61)	--	--	--	--
Constant	--	--	--	0.92* (0.46)	1.20** (0.48)	-2.49*** (0.61)	-2.10*** (0.64)
Number of Observations	170	170	170	85	85	85	85
Estimation Method	OLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
First-stage F Statistic	--	--	48.0	--	12.8	--	46.9

Notes:
In all specifications, the dependent variable is the average annual growth rate of employment by industry over the specified period.
Standard errors are in parentheses. Standard errors are clustered on 21 three-digit industry groups. Observations are weighted by industry employment in 1991.
*** p < .01
** p < .05
* p < .10

Analysis of results

Implied Employment Changes Induced by Changes in Exposure to Chinese Import Competition

			Implied Employment Effect (x1,000)		
Unit of Analysis	**Description**	**Affected Sector(s)**	1991-2001	2001-2011	1991-2011
Industry (NAICS)	Direct effect of import exposure	Manufacturing	-64.3	-105.2	-169.5

- How big are these numbers?
  - 50.7 percent of 1991-2011 manufacturing decline (334.3 thousand)
  - 20.7 per cent of the 2001-2011 manufacturing decline (507.8 thousand)
- Comparison to U.S. results
  - 'China Chock' explained 10 percent of U.S. manufacturing employment decline over 1999-2011 period
  - Difference: Chinese import penetration increased more in Canada
    - ★ 0.9 percentage points per year in Canada
    - ★ 0.5 percentage points per year in the United States

Manufacturing Industries with the Largest Declines in Employment Attributable to the Rise of Chinese Import Competition, 2001-2011

Panel A: Largest Per Cent Declines in Employment

Industry	Per Cent Change	Absolute Change
NAICS 3341 - Computer and Peripheral Equipment Manufacturing	-38.8	-6,793
NAICS 3342 - Communications Equipment Manufacturing	-37.2	-11,798
NAICS 3343 - Audio and Video Equipment Manufacturing	-36.5	-743
NAICS 3322 - Cutlery and Hand Tool Manufacturing	-24.8	-1,343
NAICS 3372 - Office Furniture (including Fixtures) Manufacturing	-21.8	-5,434
NAICS 3169 - Other Leather and Allied Product Manufacturing	-21.4	-712
NAICS 3399 - Other Miscellaneous Manufacturing	-20.7	-12,053
NAICS 3314 - Non-Ferrous Metal (except Aluminum) Production and Processing	-17.9	-2,547
NAICS 3371 - Household and Institutional Furniture and Kitchen Cabinets	-16.1	-11,389
NAICS 3352 - Household Appliance Manufacturing	-16.0	-1,327

Panel B: Largest Declines as a Share of the Total Employment Change

Industry	Per Cent of Total Change	Absolute Change
NAICS 3391 - Medical Equipment and Supplies Manufacturing	225.7	-1,885
NAICS 3342 - Communications Equipment Manufacturing	185.2	-11,798
NAICS 3345 - Navigational, Measuring, Medical and Control Instruments	158.2	-1,234
NAICS 3279 - Other Non-Metallic Mineral Product Manufacturing	158.1	-632
NAICS 3343 - Audio and Video Equipment Manufacturing	125.9	-743
NAICS 3372 - Office Furniture (including Fixtures) Manufacturing	93.5	-5,434
NAICS 3322 - Cutlery and Hand Tool Manufacturing	88.7	-1,343
NAICS 3341 - Computer and Peripheral Equipment Manufacturing	83.5	-6,793
NAICS 3399 - Other Miscellaneous Manufacturing	77.5	-12,053
NAICS 3369 - Other Transportation Equipment Manufacturing	62.1	-298

Industry spillover effects through input-output linkages

- We've measured the direct effect of import competition on employment in the industry facing that competition
- Industries also face indirect import exposure through input-output linkages with other industries
  - **Upstream effect:** an industry's exposure to competition faced by industries that buy its output
  - **Downstream effect:** an industry's exposure to competition faced by industries from which it buys inputs

Measuring upstream and downstream exposure

- Combine $\Delta IE_{j,t}$ with input-output table:

$$\Delta IE^{U}_{i,t} = \sum_{j} \hat{m}_{i,j} \Delta IE_{j,t}$$

$$\Delta IE^{D}_{i,t} = \sum_{j} \tilde{m}_{i,j} \Delta IE_{j,t}$$

  - $\hat{m}_{i,j}$ =share of industry i output purchased by industry j
  - $\tilde{m}_{i,j}$ =industry j purchases from industry i as a share of industry j output

- Higher-order effects:
  - These measure only the first-order upstream and downstream effects
  - To get full higher-order effects, invert the Leontief matrix, etc.

- Things to note about this:
  - Defined for all industries, not just manufacturing
  - Switched from NAICS to IOIC (Trau, 2005)

Estimation strategy

- Regression specification:

$$\Delta L_{j,t} = \alpha_t + \beta_1 \Delta IE_{j,t} + \beta_2 \Delta IE^x_{j,t} + e_{j,t}$$

  - $\Delta IE^x_{j,t}$ =change in indirect import exposure through I/O linkages, $x \in \{U, D\}$
  - Instruments: Replace $\Delta IE_{j,t}$ with $\Delta IEO_{j,t}$ in formula for $\Delta IE^x_{i,t}$
  - Observations weighted by initial industry employment; SEs clustered by 3-digit IOIC industry

- Given regression estimates, employment impact is computed as before

Regression estimates

Effect of Import Exposure on Employment in Canada Incorporating Input-Output Linkages, 1991-2011

	A. Direct Effects		B. First-Order Input-Output Linkages			C. Full (Higher-Order) Input-Output Linkages)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Direct import exposure	-0.99 (0.64)	-1.54* (0.83)	-1.58 (1.13)	-1.55 (1.15)	--	-1.73* (1.05)	-1.70 (1.08)	--
Upstream import exposure	--	--	0.16 (2.27)	-0.09 (2.56)	--	0.42 (1.06)	0.26 (1.24)	--
Downstream import exposure	--	--	--	0.18 (0.52)	--	--	0.11 (0.33)	--
Combined import exposure (direct + upstream)	--	--	--	--	-1.08* (0.61)	--	--	-0.72 (0.44)
Estimation Method	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
First-stage F statistics	--	53.2	48.4 511.7	82.2 1002.5 789.1	85.3	60.2 570.4	87.7 1023.5 1731.1	132.0

Notes:
In all specifications, the dependent variable is the average annual growth rate of employment by industry over the specified period.
Standard errors are in parentheses. Standard errors are clustered on 21 three-digit industry groups. All specifications include period x sector dummies, where 'sector' is either manufacturing or non-manufacturing. The number of observations is 170, and observations are weighted by industry employment in 1991.
* $p < 0.1$
** $p < .05$
*** $p < .01$

Analysis of results

Implied Employment Changes Induced by Changes in Exposure to Chinese Import Competition

			Implied Employment Effect (x1,000)		
Unit of Analysis	**Description**	**Affected Sector(s)**	1991-2001	2001-2011	1991-2011
Industry (NAICS)	Direct effect of import exposure	Manufacturing	-64.3	-105.2	-169.5
Industry (IOIC)	Direct effect of import exposure	Manufacturing	-72.5	-118.6	-191.1
Industry (IOIC)	Direct and first-order upstream effects of import exposure	Total	-71.5	-131.3	-202.8
Industry (IOIC)	Direct and first-order upstream effects of import exposure	Manufacturing	-60.2	-100.9	-161.1

- Little evidence of important input-output spillovers
  - Increase losses by 11 percent over 2001-2011
  - Increase losses by 6 percent over 1991-2011
- Tiny effect compared to United States
  - Increased losses by factor of 2.8 to 3.5 over 1999-2011 period (Acemoglu *et al.*, 2016)
  - Why so different in Canada?

Reallocation and demand effects in local labour markets

- Results so far may fail to capture some effects of import exposure
  - **Labour reallocation:** Job losses in one industry increase labour supply available for other industries
  - **Aggregate demand:** Job losses in one industry reduce incomes, leading to lower consumption and to job losses in other industries
- Approach: Use geographic variation to measure part of (the net effect of) these forces that operates within local labour markets

Local labour markets

- Census metropolitan areas (CMAs) and census agglomerations (CAs)
  - Definition based (in part) on commuting flows
  - Cover 82 percent of working-age population in 2011
  - Use 129 CMAs/CAs present in 1991, 2001 and 2011 data
- Chinese import exposure by locality:

$$\Delta IE^{L}_{l,t} = \sum_{j} \frac{L_{l,j,t}}{L_{l,t}} \Delta IE_{j,t}$$

  - Employment-weighted average of industry exposures
  - Variation across localities comes from differences in employment structure
- Instrument:
  - Replace $\Delta IE_{j,t}$ with $\Delta IEO_{j,t}$ in the formula above

Estimation strategy

- Specification 1:

$$\Delta E_{l,t} = \alpha_t + \beta \Delta IE^L_{l,t} + X'_{l,t}\gamma + e_{l,t}$$

  - $\Delta E_{l,t}$ =annual percentage-point change in employment rate
  - $\Delta IE^L_{l,t}$ =import exposure of locality l
  - $X_{l,t}$ contains region dummies and initial manufacturing employment share
  - Observations weighted by initial CMA/CA working-age population; SEs clustered by CMA/CA

Estimation strategy

- Specification 2:

$$\begin{aligned}\Delta E_{k,l,t} &= \alpha_{k,t} + \beta_1 \Delta IE^L_{l,t} \mathbf{1}\{exposed\} + \beta_2 \Delta IE^L_{l,t} \mathbf{1}\{non-exposed\ tradable\} \\ &\quad + \beta_3 \Delta IE^L_{l,t} \mathbf{1}\{non-exposed\ non-tradable\} + X'_{l,t}\gamma + e_{k,l,t}\end{aligned}$$

- This allows the employment effect to differ by 'sector'
  - **Exposed:** Industries in which import exposure increased at least 2 percentage points per year
  - **Non-exposed tradable:** Any non-service industry in manufacturing, agriculture, forestry, and mining and oil and gas not already defined as 'exposed'
  - **Non-exposed non-tradable:** All remaining industries

Estimation results

Effect of Import Exposure on Employment in Canadian Local Labour Markets

	A. Total Employment Effect		B. Sectoral Employment Effects	
	(1)	(2)	(3)	(4)
CMA/CA import exposure	-1.05***	-1.00***	--	--
	(0.28)	(0.27)		
CMA/CA import exposure x 𝟙{exposed}	--	--	-1.62***	-1.78***
			(0.21)	(0.22)
CMA/CA import exposure x 𝟙{non-exposed tradable}	--	--	-0.19	-0.35
			(0.26)	(0.25)
CMA/CA import exposure x 𝟙{non-exposed non-tradable}	--	--	0.67	1.06**
			(0.56)	(0.51)
Estimation Method	OLS	2SLS	OLS	2SLS
Number of observations	258	258	774	774
First-stage F statistics	--	792.5	--	1,803.3

Notes:
In columns (1) and (2), the dependent variable is the annual percentage-point change in the employment rate within a CMA/CA over the 1991-2001 and 2001-2011 periods. In columns (3) and (4), the dependent variable is the annual percentage-point change in the ratio of sectoral employment to the total working-age population within a CMA/CA over the 1991-2001 and 2001-2011 periods and for the exposed, non-exposed traded and non-exposed non-traded sectors as defined in the main text.
Standard errors are in parentheses. Standard errors are clustered on 129 CMAs/CAs. Specifications (1) and (2) include period and region dummies; specifications (3) and (4) include period x sector dummies, region dummies, and the locality's initial manufacturing employment share interacted with sector dummies. In all specifications, observations are weighted by CMA/CA working-age population (i.e. population aged 15 and over) in 1991.
* $p < 0.1$
** $p < .05$
*** $p < .01$

Analysis of results

Implied Employment Changes Induced by Changes in Exposure to Chinese Import Competition

			Implied Employment Effect (x1,000)		
Unit of Analysis	**Description**	**Affected Sector(s)**	1991-2001	2001-2011	1991-2011
Locality (CMA/CA)	Direct, labour reallocation and local demand effects of import exposure	Total	-59.4	-169.1	-228.6
Locality (CMA/CA)	Direct, labour reallocation and local demand effects of import exposure	Total	-55.7	-153.6	-209.3
		Exposed	-92.6	-255.4	-347.9
		Non-exposed tradable	-18.3	-50.7	-69.0
		Non-exposed non-tradable	55.3	152.4	207.7

- Losses in exposed sector partially offset by gains in non-exposed non-tradables
  - Not much evidence of within-locality demand spillovers

Analysis of results

- Why reallocation into nontradables rather than non-exposed tradables?
  - Declining aggregate trade balance over 2001-2011 period
  - Reallocation across localities not captured; maybe especially important for oil and gas
- Comparison with results for the United States
  - Acemoglu *et al.* (2016) found no statistically significant reallocation into non-exposed sectors
  - They interpreted this as evidence of strong within-locality demand effects
  - Our results suggest reallocation was less inhibited by negative demand effects in Canada

Localities with the Largest Declines in Employment Attributable to the Rise of Chinese Import Competition, 2001-2011

Panel A: Largest Per Cent Declines in Employment

Industry	Per Cent Change	Absolute Change
CMA/CA 454 - Sorel-Tracy, Quebec	-3.9	-684
CMA/CA 450 - Granby, Quebec	-3.9	-1172
CMA/CA 440 - Victoriaville, Quebec	-3.5	-702
CMA/CA 543 - Brantford, Ontario	-3.3	-1370
CMA/CA 428 - Saint-Georges, Quebec	-3.2	-463
CMA/CA 447 - Drummondville, Quebec	-2.9	-947
CMA/CA 433 - Sherbrooke, Quebec	-2.8	-2117
CMA/CA 465 - Salaberry-de-Valleyfield	-2.8	-490
CMA/CA 502 - Hawkesbury, Ontario/Quebec	-2.8	-138
CMA/CA 452 - Saint-Hyacinthe, Quebec	-2.7	-659

Panel B: Largest Declines as a Share of the Total Employment Change

Industry	Per Cent of Total Change	Absolute Change
CMA/CA 595 - Thunder Bay, Ontario	402.8	-161
CMA/CA 571 - Midland, Ontario	248.9	-336
CMA/CA 465 - Salaberry-de-Valleyfield	153.0	-490
CMA/CA 566 - Owen Sound, Ontario	106.9	-209
CMA/CA 501 - Cornwall, Ontario	87.3	-589
CMA/CA 553 - Stratford, Ontario	64.9	-396
CMA/CA 527 - Cobourg, Ontario	58.9	-180
CMA/CA 444 - Shawinigan, Quebec	41.1	-382
CMA/CA 210 - Kentville, Nova Scotia	31.7	-16
CMA/CA 547 - Norfolk, Ontario	26.0	-103

Conclusion: Impact of 'China Shock' in Canada

- Direct effect in manufacturing industries:
  - 105 thousand manufacturing jobs over 2001-2011 period
  - 20.7 per cent of total decline over 2001-2011 period
- Not much evidence for important spillover effects through input-output linkages
- Accounting for reallocation and aggregate demand effects within local labour markets:
  - 150 to 170 thousand jobs over 2001-2011 period
  - Large losses in exposed (manufacturing) industries, partially offset by gains in non-exposed non-tradable industries
- This is not a comprehensive assessment of the welfare impact of trade with China
- But effects on the 'losers' should not be ignored