Identifying Chinese Supply Shocks – Effects of Trade on Labor Markets

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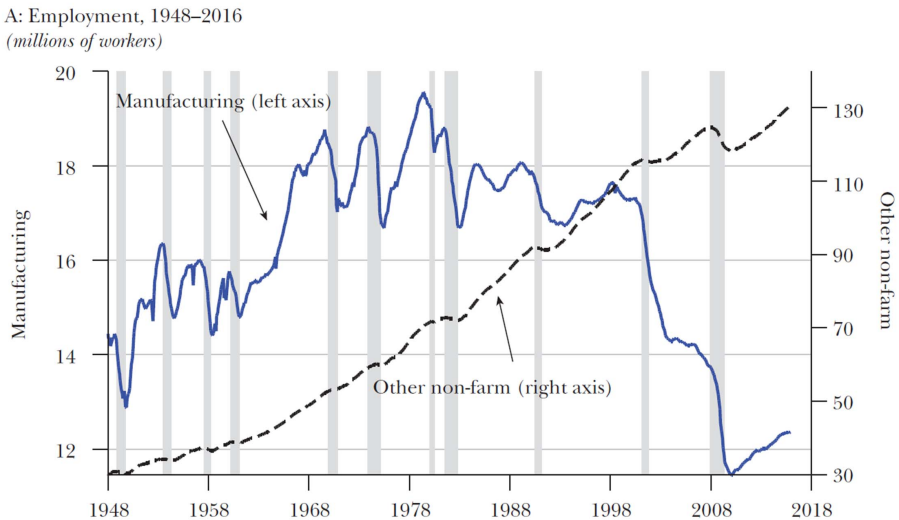
Motivation

Manufacturing
employment in the U.S.
declined by roughly 30 percent
since the 1990s (see figure).

"...import competition
explains one-quarter
of the contemporaneous
aggregate decline in
US manufacturing employment
[between 1991 and 2007]."

Autor, Dorn, Hanson 2013



Source: Fort, Pierce and Schott 2018

Motivation

Autor, Dorn and Hanson (ADH): *The China Syndrome: Local Labor Market Effects of Import Competition in the United States.* (AER 2013)

- ...impute the increase in import penetration per worker for *commuting zones* through local industry composition.
- ...regress the change in manufacturing employment on the change in import penetration per worker.
- ...instrument "the growth in U.S. imports from China using Chinese import growth in other high-income markets"

This Paper

Part I: Scrutinizes identification strategy of ADH 2013 – can neglect 'demand shocks'?

Part II: Proposes a strategy to directly identify supply-induced supply shocks.

Part III: ...adjusts the estimation strategy, re-estimates

- ...reduced form as in ADH 2013
- ...GE effects from Caliendo et al. 2019.

Overall, estimated job losses are larger, distribution across labor market segments (gender, non-manufacturing) changes.

Literature

- ADH strategy: Autor, Dorn and Hanson (2013), Autor and Dorn (2013)), Autor, Dorn, Hanson and Song (2014), Acemoglu, Autor, Dorn, Hanson, and Price (2014, 2016) Autor, Dorn, Hanson, and Majlesi (2020), Autor, Dorn and Hanson (2019). Ashournia, Munch, Nguyen (2014), Balsvik et al. (2015), Dauth et al. (2014), and Malgouyres (2017), Caliendo, Dvorkin, Parro (2019) Adao, Arkolakis, Esposito (2020), Galle, Rodriguez-Clare, Yi (2020), and Rodriguez-Clare, Ulate, Vasquez (2020)
- Some challengers: Magyari (2017), Feenstra, Ma, and Xu (2017a and 2017b) Feenstra and Sasahara (2017)
- Other approaches: Bloom, Draca, van Reenen (2016), Keller and Utar (2016), Utar (2018) Bloom, Handley, Kurman, Luck (2016), Dix-Carneiro and Kovak (2019)

Scrutinizing exports: China and Other EMEs

Part I

Scrutinizing the assumption that

Chinese exports are supply-driven.

ADH estimation strategy

Main regression:

$$\Delta L_i^m = \alpha + \beta \Delta IPW_i + \gamma controls_i + \varepsilon_i$$

where

- i identifies the commuting zone (CZ)
- L_i^m manufacturing employment per worker in CZ i
- IPW_i is import penetration per worker in thousand 2007 USD
- Δ indicates changes (1991 - 2000 and 2000 - 2007)

ADH estimation strategy

1. The **regressor** *Import penetration per worker*:

$$\Delta IPW_i^{CN,US} = \sum_j l_{ij} \frac{\Delta E_j^{CN,US}}{L_j},$$

2. The **instrument**:

$$\Delta IPW_i^{CN,OAE} = \sum_j l_{ij,lagged} \frac{\Delta E_j^{CN,OAE}}{L_{j,lagged}},$$

- $\Delta E_j^{CN,D}$ increase in Chinese export to D, in industry j
- L_j – number of workers in industry j (initial period)
- l_{ij} – industry j's employment share in CZ i (initial period)
- both employment variables lagged in instrument

ADH estimation strategy

Assumption for instrument:

- product-level "...import demand shocks in high-income countries are not the primary cause of China's export surge."
- product-level demand shocks are uncorrelated across high-income countries.

Part I: Exports from China and Other EMEs

Idea: Consider a product-market of many producers,

- positive supply shocks to one of the producers – say China – increases China's sales at the expense of its competitors' sales.

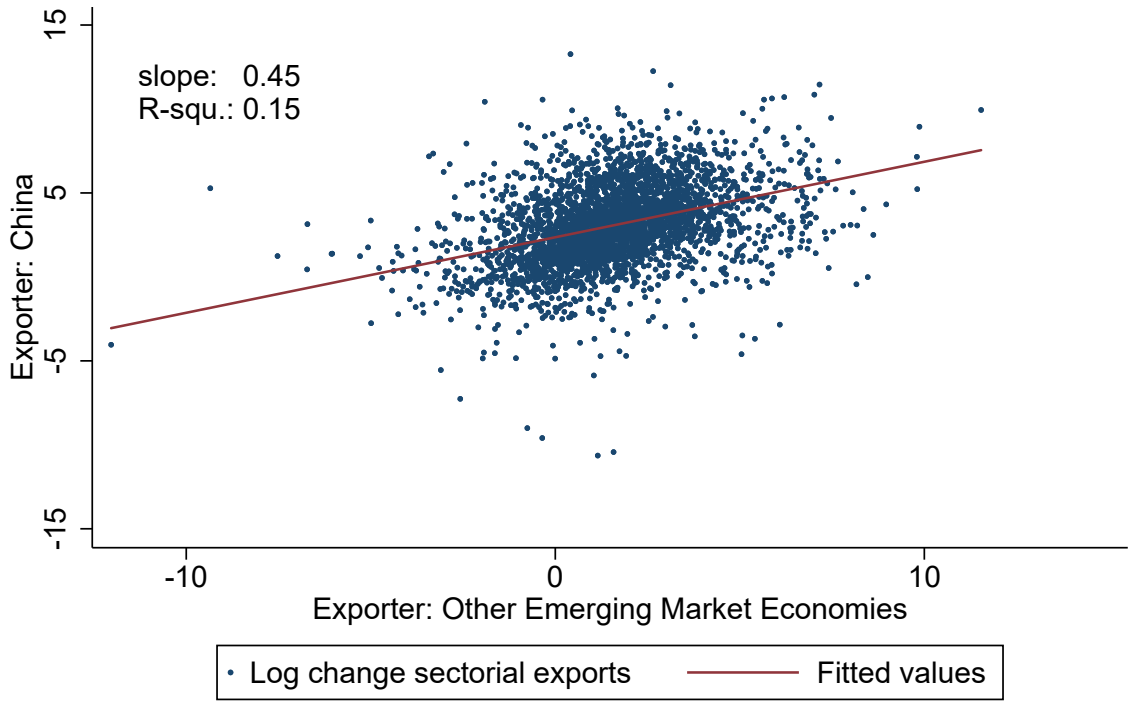
  ...induce a negative correlation of sectorial export growth of China and 'similar', other EMEs.

- a positive demand shock increases sales of all producers alike.

  ...implies a positive correlation of sectorial export growth of China and other EMEs.

Part I: Exports from China and OEMEs

Figure: **Sectorial export growth of China and Other EMEs**, by 6-digit HS classification, 1991 - 2007



Importers: Australia, Denmark, Germany, Finland, New Zealand, Japan, Spain, Switzerland, and the United States. OEME: from Auer and Fischer 2010.

Part I: Exports from China and OEMEs

Main Messages

1. A substantial part of sectoral Chinese export growth to advanced economies seems to be driven by other factors than China-specific supply shocks – e.g., demand shocks.

2.

CHN and OEME exports – checks

Positive correlation preserved

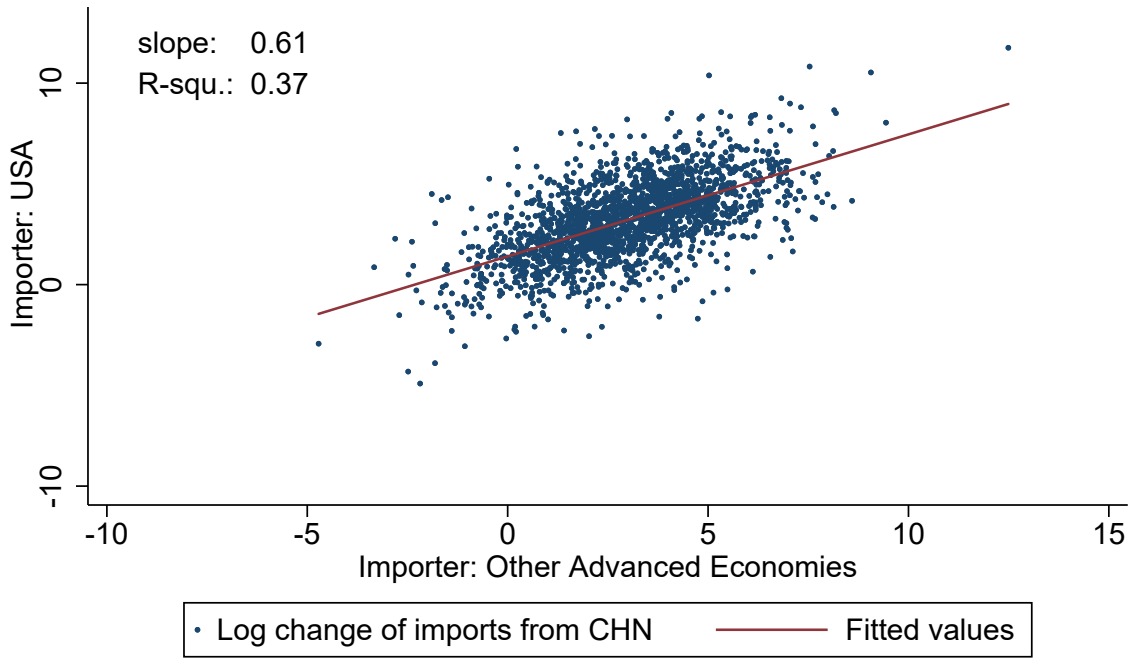
- in trade volumes (instead of values) – addresses quality upgrading.
- for homogeneous and differentiated goods (Rauch 1999 classifications) – addresses substitution effects.
- controlling for importer and product fixed effects (in regression with bilateral trade data).

more results

CHN and OEME exports – checks

...are the "demand shocks" of US and OAE correlated?

Figure: Common Component of CHN and OEMEs export growth by destination (US and OAE), 1991 to 2007



CHN and OEME exports by destination – common factors

Main Messages

1. A substantial part of sectoral Chinese export growth to advanced economies seems to be driven by other factors than China-specific supply shocks – e.g., demand shocks.
2. Those other factors seem to correlate across export destinations – the U.S. and OAE.

$\Rightarrow$ ADH identification strategy potentially problematic.

Part II: Isolating Supply-driven Chinese Exports

Part II

Extracting the China-specific supply component

Exports: China and Other EMEs

Demand in sector j in period $t = 0, 1$:

$$q_{j,t} = a_{j,t} p_{j,t}^{-\sigma_j} \tag{1}$$

Supply in sector j in period 1, relative to period 0:

$$q_{c,j,1} = \begin{cases} \chi_j q_{c,j,0} & \text{if } c = OE \\ \chi_j^{CN} \chi_j q_{c,j,0} & \text{if } c = CN \end{cases} \tag{2}$$

- $q_{j,t} = q_{OE,j,t} + q_{CN,j,t}$
- χ_j^{CN} – China-specific supply shock
- χ_j – supply shock common to all EMEs
- allow for demand and other shocks through a_j

Part II: Isolating Supply-driven Chinese Exports

Export value of country c in sector j at time t is $E_{c,j,t} = p_{j,t} q_{c,j,t}$. The percentage increase in $E_{c,j}$ is therefore

$$\frac{dE_{c,j}}{E_{c,j}} = \frac{dp_j}{p_j} + \frac{dq_{c,j}}{q_{c,j}}.$$

so that

$$\frac{dE_{CN,j}}{E_{CN,j}} - \frac{dE_{OE,j}}{E_{OE,j}} = \chi_j^{CN} - 1 \tag{3}$$

Part II: Isolating Supply-driven Chinese Exports

Derivative of Chinese exports w.r.t. China-specific shock χ_{CN} is

$$\frac{dE_{CN,j}}{d\chi_j^{CN}} = \left[p'(q_j)q_{CN,j} + p_j(q_j)\right] \frac{dq_{CN,j}}{d\chi_j^{CN}} \tag{4}$$

Part II: Isolating Supply-driven Chinese Exports

Eqs. (3) and (4) yield, when replacing differentials with differences
Supply-induced Chinese export growth

$$\begin{aligned}
\frac{\widehat{\Delta E}_{CN,j}}{E_{CN,j,0}} &= \frac{E_{CN,j,1} - E_{CN,j,0}}{E_{CN,j,0}} \\
&= \left[1 - \frac{1}{\sigma_j} \frac{E_{CN,j}}{E_{OE,j} + E_{CN,j}}\right] [\chi_{CN,j} - 1] \\
&= \left[1 - \frac{1}{\sigma_j} \frac{E_{CN,j,0}}{E_{OE,j,0} + E_{CN,j,0}}\right] \left[\frac{E_{CN,1}}{E_{CN,0}} - \frac{E_{OE,1}}{E_{OE,0}}\right]
\end{aligned}$$

- All variables observable (σ_j from Broda and Weinstein 2004).
- Growth of E_{OE} exports matter, *level* largely irrelevant.

Part II: Isolating Supply-driven Chinese Exports

China's supply-induced increase in sectorial exports.

Table 2: Summary statistics – Chinese exports, total and supply-induced

	Imports from China	Explained by Chinese Supply	Increase explained by Chinese Supply (%)
	(1)	(2)	(3)
United States			
1991	26.0	-	-
2000	120.7	68.8	45.2%
2007	330.0	286.4	79.2%
Other advanced countries			
1991	28.0	-	-
2000	93.7	62.8	53.0%
2007	264.6	184.9	53.4%

Notes: Numbers in billion 2007 US$. Source: UN Comtrade and own calculations.

- Obtain direct decomposition of trade into supply-induced and rest, sector by sector.
- Four-fifth (half) of Chinese export growth to U.S. after (prior to) China's accession to the WTO.

Part III: Adjusting estimation strategy

Part III

Adjusting the ADH estimation strategy.

Part III: Adjusting estimation strategy

ADH model:

$$\Delta(L_i^m) = \alpha + \beta \Delta IPW_i + \gamma controls + \varepsilon_i$$

where

- i identifies the commuting zone (CZ)
- L_i^m manufacturing employment per worker in CZ i
- IPW_i is import penetration per worker in thousand 2007 USD
- Δ indicates changes (1991 - 2000 and 2000 - 2007)

Controls include:

- Ratios of immigration, female and routine-task employment, geographic dummies.

Part III: Adjusting estimation strategy

Two possible estimation strategies:

1. The **supply-induced regressor**:

$$\widehat{\Delta IPW}_i^{CN,US} = \sum_j l_{ij} \frac{\widehat{\Delta E}_j^{CN,US}}{L_j},$$

2. The **supply-induced instrument**:

$$\widehat{\Delta IPW}_i^{CN,US} = \sum_j l_{ij} \frac{\widehat{\Delta E}_j^{CN,OAE}}{L_j},$$

- where $\widehat{\Delta E}_j^{CN,D}$ is China's supply-induced sectorial exports.

Part III: Adjusting estimation strategy

Estimation strategy

Our 2SLS strategy, following ADH:

$$\Delta L_i^m = \alpha + \beta \cdot \Delta IPW_i^{CN,US} + \gamma \cdot controls_i + \varepsilon_i.$$

and

$$\Delta IPW_i^{CN,US} = \rho_1 + \rho_2 \cdot \widehat{\Delta IPW}_i^{CN,OAE} + u_i.$$

Part III: Results from adjusted estimation strategy

Baseline Estimations

Table 3: Baseline Estimates, Balanced Panel 1991-2007

Dep Var: 10x Annual Change in Manufacturing Empl./Working-Age Population (in PP)

	(1)	(2)	(3)	(4)	(5)	(6)
	(i) Replication ADH, 2SLS					
$\Delta IPW^{CN,US}$	-0.703***	-0.538***	-0.472***	-0.444***	-0.501***	-0.533***
	(0.066)	(0.105)	(0.101)	(0.091)	(0.100)	(0.102)
1st Stage F-Stat.	104.120	53.965	47.937	45.279	48.714	46.619
	(ii) Instrument: Supply-Induced exports to OAE					
$\widehat{\Delta IPW}^{CN,US}$	-0.905***	-0.633***	-0.552***	-0.454***	-0.653***	-0.691***
	(0.106)	(0.156)	(0.151)	(0.142)	(0.187)	(0.188)
$\Delta IPW^{L,\ CN,US,res}$	-0.160	-0.081	-0.058	-0.004	-0.087	-0.093
	(0.109)	(0.097)	(0.093)	(0.084)	(0.121)	(0.121)
1st Stage F-Stat.	43.819	32.332	30.262	29.961	28.571	27.448

Columns (1) to (6) correspond to those of Table 3 of ADH successively including the control variables. These are: the percentage of employment in manufacturing, percentage of college-educated population, percentage of foreign-born population, percentage of employment among women, percentage of employment in routine occupations, average offshorability index of occupation, and census

Estimated impact of trade on manufacturing employment in line with ADH 2013.

Part III: Results from adjusted estimation strategy

Estimated employment losses (million jobs)

- Period 1990 - 2000
  (lab. force x increased IPW x share supply ind. x coefficient):

$$0.599 \approx \frac{157.6 + 178.7}{2} x 1.14 x 0.452 x \frac{0.691}{100}$$

- Period 2000 - 2007:

$$1.877 \approx \frac{178.7 + 194.3}{2} x 1.84 x 0.792 x \frac{0.691}{100}$$

- Effects larger than in ADH (1.5 million) and period by period.
- General caveat: estimations refer to *differential* effect across regions, inept to assess level effects.

Part III: Summary and interpretation

- Estimations with supply-induced Chinese exports suggest that...
  - ...the coefficient of interest in the baseline is slightly larger in absolute magnitude and identical in significance to the one in ADH.
  - ...implied overall job losses in manufacturing sector larger than in ADH because larger share of trade is supply-induced.
  - ...wage losses are muted for college educated female workers and non-college male workers – possibly due to selection. Table Wages
  - ...wage losses become insignificant in non-manufacturing sector. Table Wages NMS

General Equilibrium: Caliendo et al. 2019

Caliendo, Dvorkin, and Parro 2019: "Trade and labor market dynamics: General equilibrium analysis of the China trade shock."

- EK-type model (Ricardian trade, probabilistic productivity distribution),
  - 38 countries plus 50 U.S. states
  - 12 manufacturing, 11 non-manufacturing sectors (defining U.S. labor market segments)
  - linkages through intermediate inputs
  - costly migration between U.S. states (responding to real wages and individual preference shocks)

General Equilibrium: Caliendo et al. 2019

- General Equilibrium
  - allows to assess absolute employment (welfare) gains and losses.
- Caliendo et al. 2019 feed model with exogenous Chinese export growth, identified through ADH method.
  - match baseline model to trade and population/migration data by state and sector (2000-2007).
  - calibrate Chinese sectoral 'productivity' changes to match exogenous Chinese export growth.
  - conduct counterfactual, absent of Chinese 'productivity' changes.
- Model implies 0.55 million manufacturing employment losses (real wage changes, welfare gains).

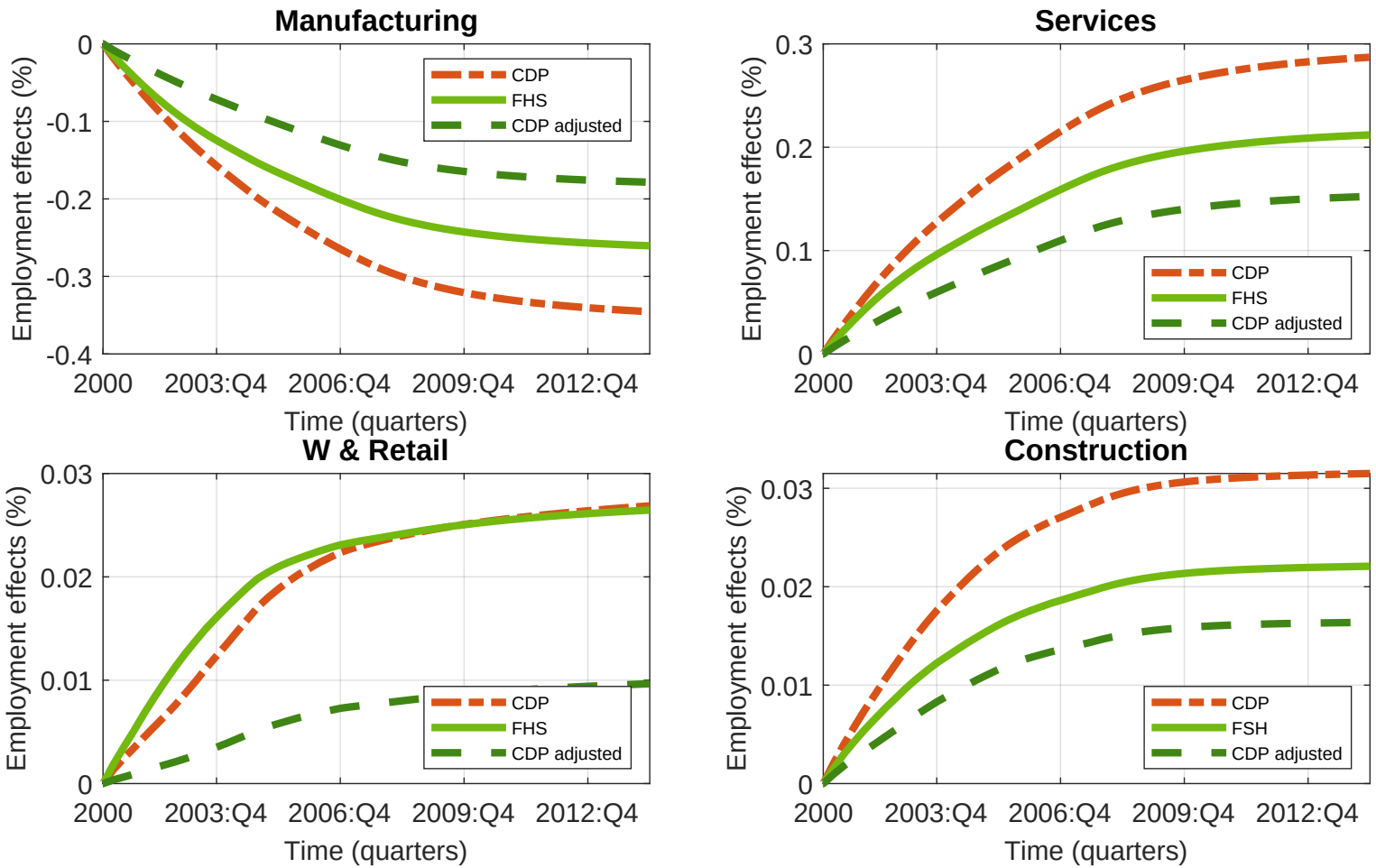
Exercise: Caliendo et al. 2019

We adapt the CDP strategy...

- Adjust original counterfactual to match the total import growth identified as supply-driven in ADH 2013 (share 0.48)
  - implies ca. 0.29 mio manuf. employment losses
- Feed model with own 'supply-induced' Chinese exports for the 12 sectors
  - implies ca. 0.42 mio manuf. employment losses
  - changed distribution of employment losses, welfare changes.
- Improve the model's match to the data.

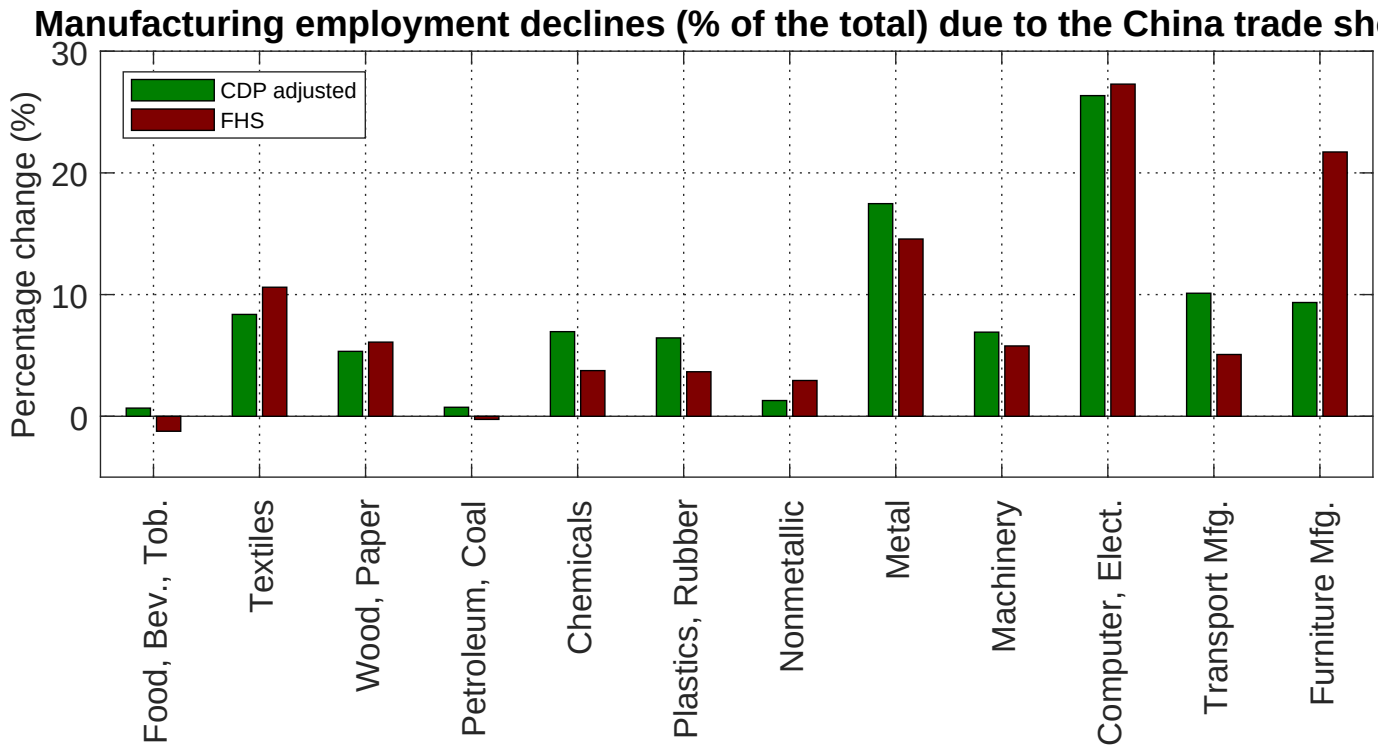
Additional Exercise: Caliendo et al. 2019

Comparison supply-induced manuf. employment losses, aggregate



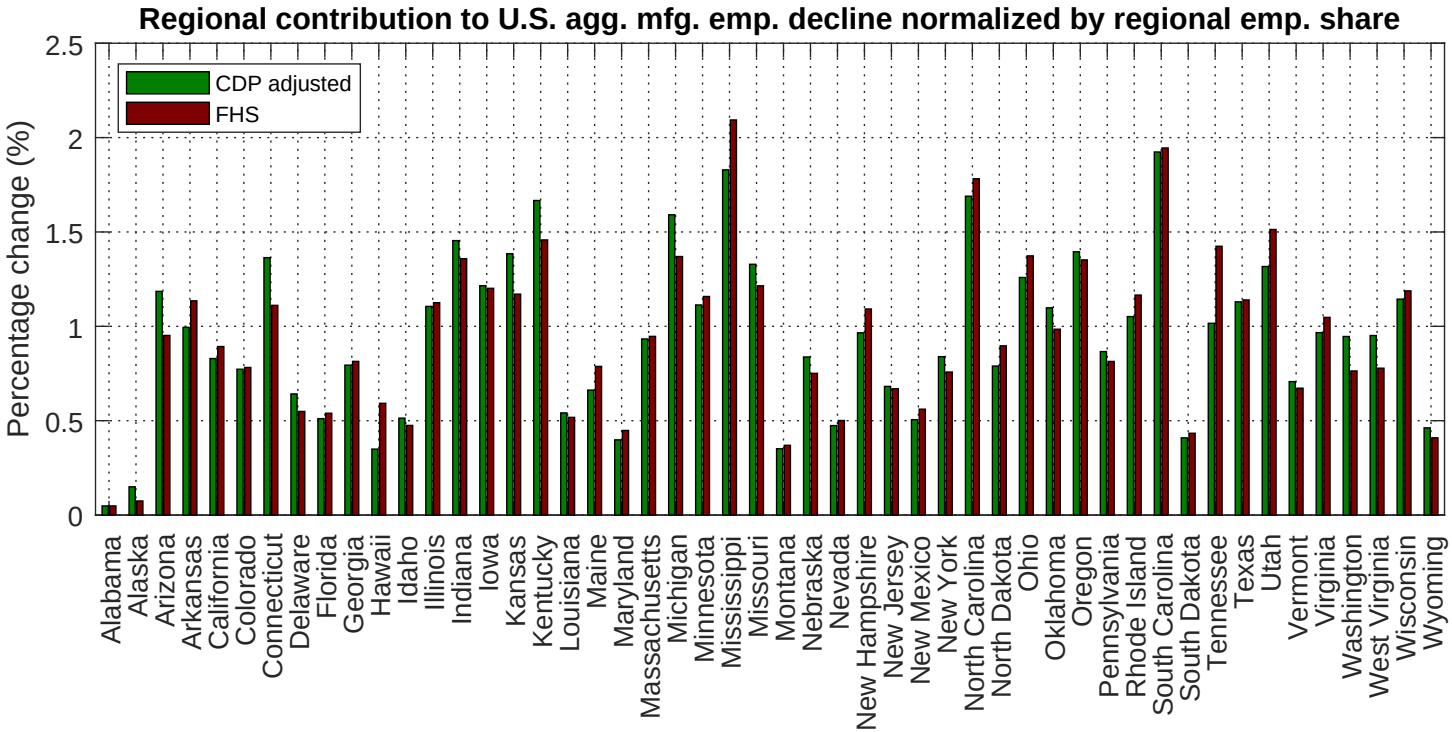
Additional Exercise: Caliendo et al. 2019

Comparison supply-induced manufacturing employment losses, 12 Sectors



Additional Exercise: Caliendo et al. 2019

Comparison supply-induced manuf. employment losses (normalized by workforce), U.S. states



Conclusion

Main Messages

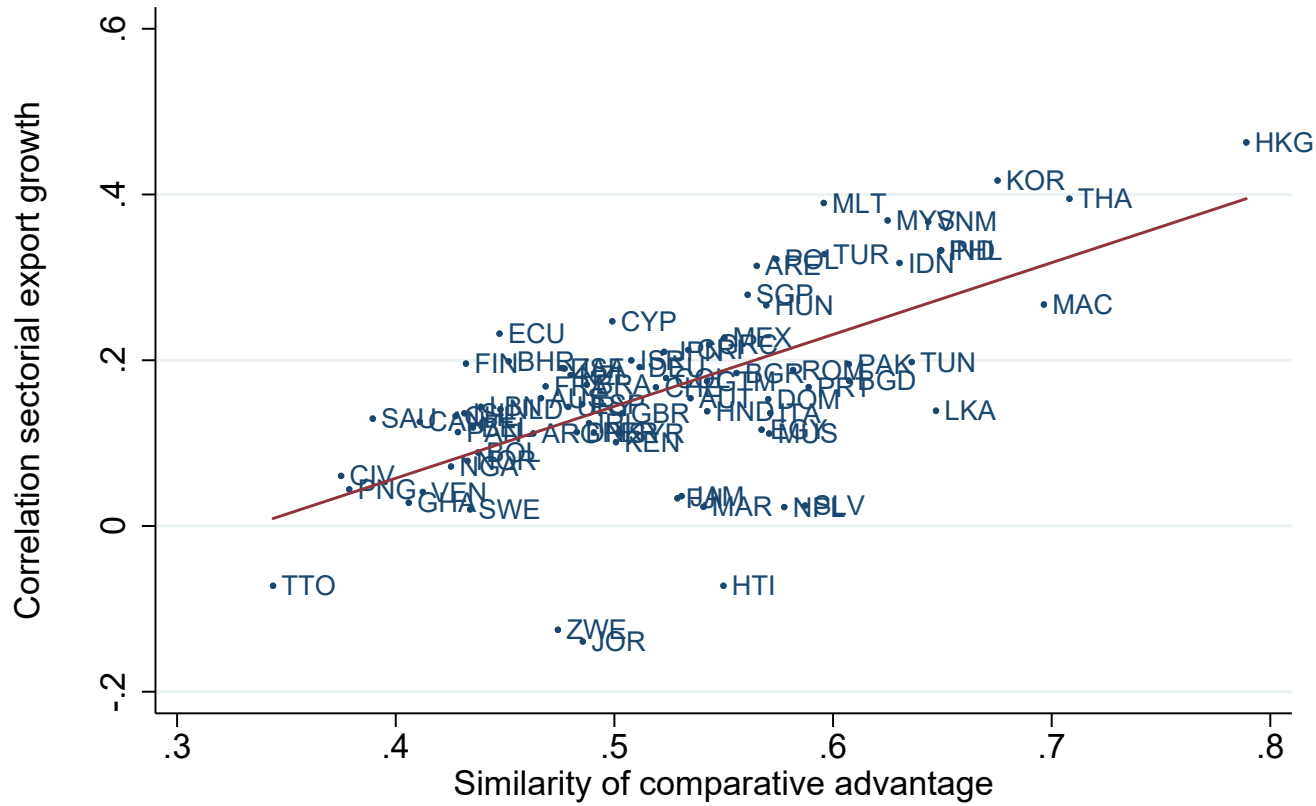
1. The identification strategy by ADH possibly problematic – common 'demand' shocks present.

2. Alternative identification strategy resolves that problem, yields direct identification of supply-induced export growth (80% of total instead of 48% in 2000-2007).

3. Adapted strategy renders
   - reduced-form baseline: slightly larger coefficients, higher implied employment losses (2.5 instead of 1.5 mio), qualitatively different effects across labor market segments.
   - GE: higher implied employment losses (0.42 mio) rel. to corrected baseline (0.29 mio). Different distribution of losses across sectors and (somewhat) geography.

Additional Material – Exports: China and Other EMEs

Figure: Synchronized export growth and similarity of comparative advantage, 1991 to 2007



Additional Material

The positive correlation of China's and OEEs' sectorial export growth survives when controlling for country-effects and sector-effects.

$$\Delta E_j^c = \beta \cdot \Delta E_j^{CN} * prox_c^{CN} + controls_{cj} + \varepsilon_{cj},$$

- $prox_c^{CN}$ is a measure of similarity of comparative advantage between c and CN.

Additional Material

Table 1: Conditional correlations and proximity of comparative advantage

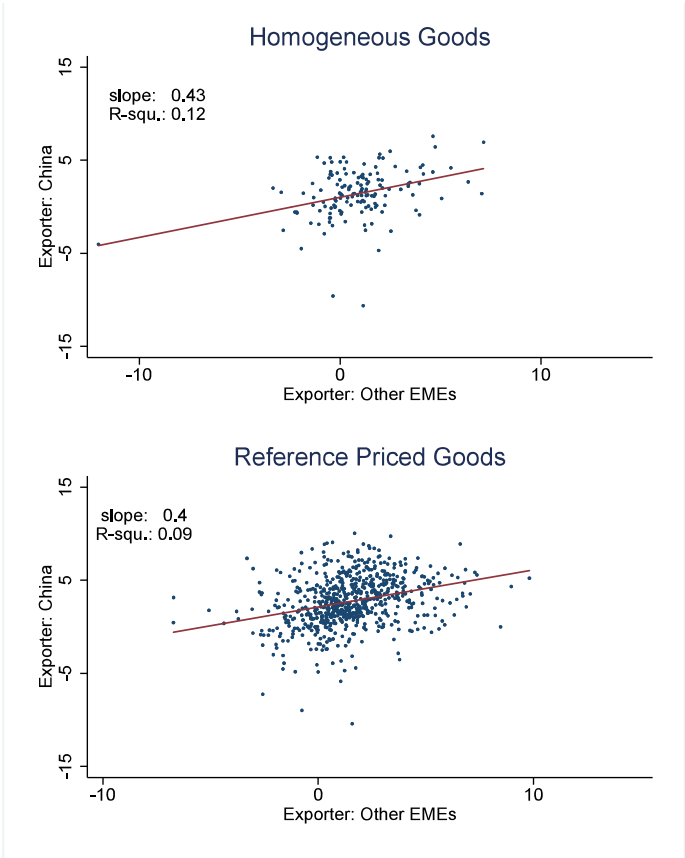
Dep. variable: $\Delta ln(E_j^c)$ = log change in exports, 1991 to 2007						
	I	II	III	IV	V	VI
Def. proximity:	Correlation initial export shares			Similarity initial GDP p.c.		
$\Delta ln(E_j^{CN})$	-0.453***			0.125***		
	(0.023)			(0.005)		
$prox_c$	-1.480***	-0.381		0.820***	0.924***	
	(0.183)	(1.765)		(0.050)	(0.349)	
$\Delta ln(E_{CN}^j) * prox_c$	1.253***	1.076***	1.178***	0.305***	0.263***	0.240***
	(0.044)	(0.197)	(0.190)	(0.013)	(0.053)	(0.049)
HS fe	no	yes	yes	no	yes	yes
Country fe	no	no	yes	no	no	yes
Observations	108,416	108,416	108,416	108,416	108,416	108,416
R-squared	0.06	0.21	0.28	0.08	0.22	0.28

Notes: Exports are those reported as imports by nine advanced economies for which disaggregated data of 6-digit HS classes are available for 1991 onwards. Robust standard errors, clustered at exporter level, in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

CHN and OEME exports – checks

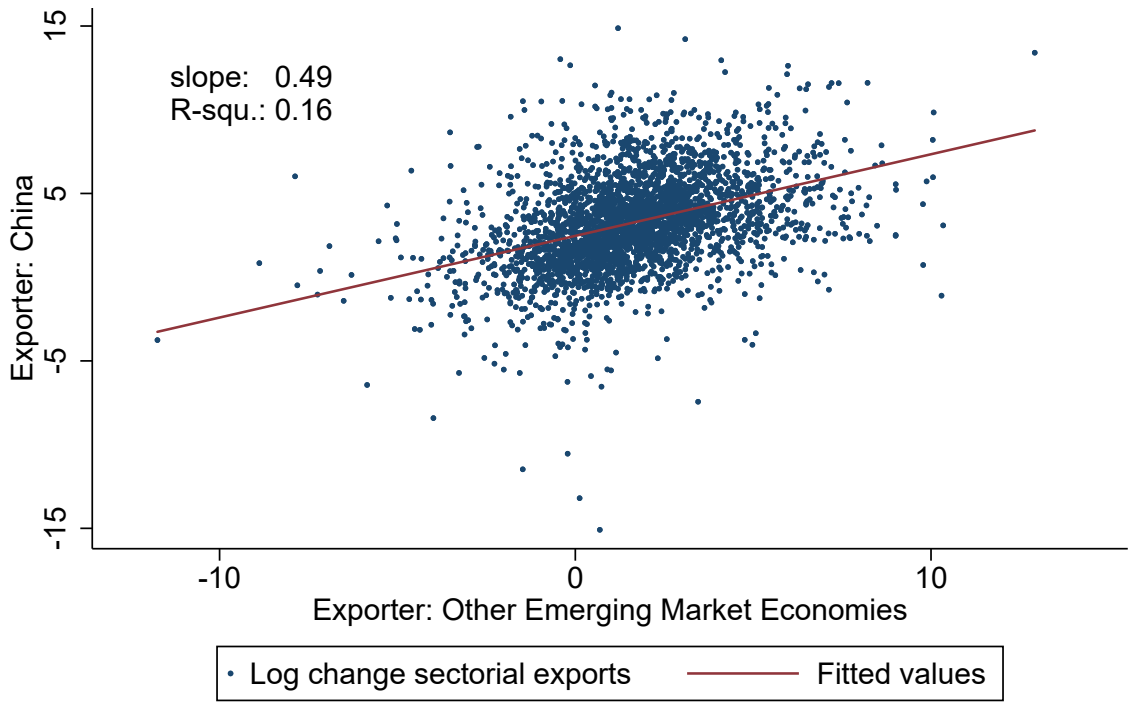
Figure: **Sectorial export growth of China and Other EMEs**, Substitutability, 1991 - 2007

Figure C5: **Homogeneous and Differentiated Goods: China's Sectoral Export Growth**, 1991 to 2007



Additional Material – Export Volumes

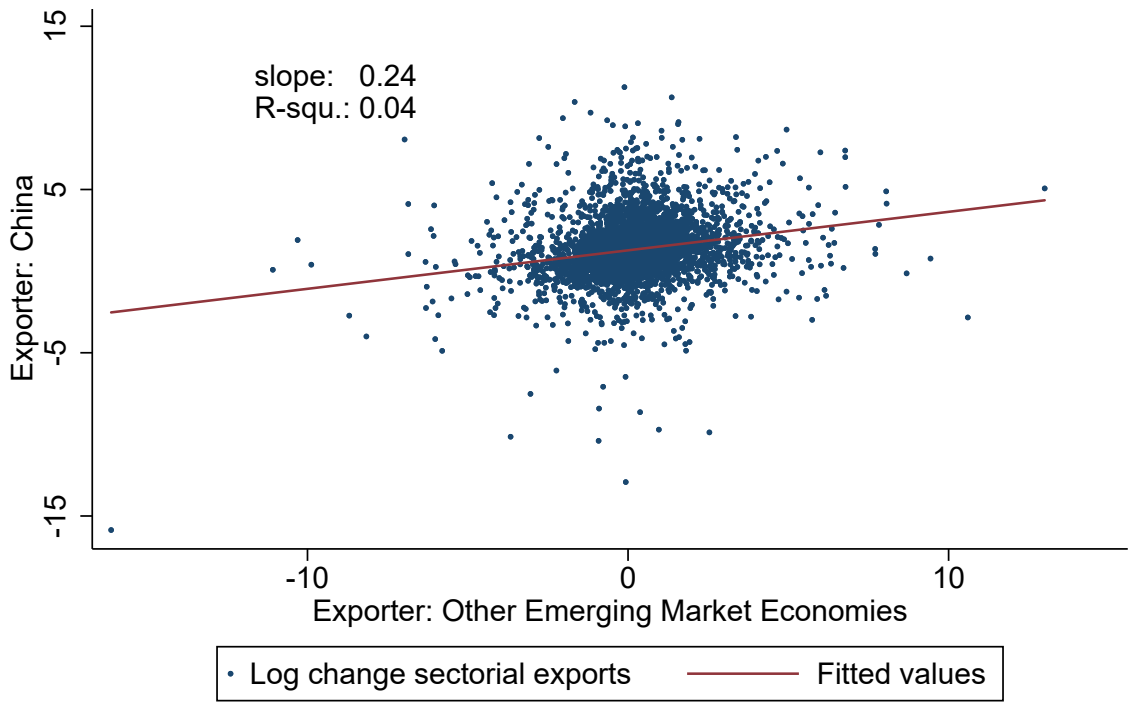
Figure: **Sectorial export growth of China and other EMEs**, by 6-digit HS classification, 1991 - 2007



Importers: Australia, Denmark, Germany, Finland, New Zealand, Japan, Spain, Switzerland, and the United States. OEE: from Auer and Fischer 2010.

Additional Material – Export Volumes

Figure: **Sectorial export growth of China and other EMEs**, by 6-digit HS classification, 2000 - 2007



Importers: Australia, Denmark, Germany, Finland, New Zealand, Japan, Spain, Switzerland, and the United States. OEE: from Auer and Fischer 2010.

back

Part III: Results from adjusted estimation strategy

Cross section – 2000 to 2007

Table 4: Baseline Estimates, Cross-Section 2000-2007

Dep Var: 10x Annual Change in Manufacturing Empl./Working-Age Population (in PP)

	(1)	(2)	(3)	(4)	(5)	(6)
	(i) Replication ADH, 2SLS					
$\Delta IPW^{CN,US}$	-0.671***	-0.340***	-0.344***	-0.342**	-0.345***	-0.386***
	(0.068)	(0.116)	(0.129)	(0.133)	(0.114)	(0.120)
1st Stage F-Stat.	77.391	34.742	29.959	27.364	30.237	27.900
	(ii) Instrument: Supply-Induced exports to OAE					
$\widehat{\Delta IPW}^{CN,US}$	-0.740***	-0.461***	-0.519***	-0.497***	-0.595***	-0.622***
	(0.108)	(0.149)	(0.168)	(0.173)	(0.179)	(0.182)
$\Delta IPW^{L,\ CN,US,res}$	-0.073	-0.078	-0.087	-0.067	-0.112	-0.093
	(0.091)	(0.082)	(0.088)	(0.083)	(0.107)	(0.107)
1st Stage F-Stat	25.903	21.237	19.977	21.806	19.974	19.485

Columns (1) to (6) correspond to those in Autor et al. (2013a) successively including the control variables. See also notes to Table 3. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

...with stable coefficients in post-WTO accession period.

Part III: Results from adjusted estimation strategy

Wage Changes by Labor Market Segments (I/II)

Dep Var: Ten-year equivalent changes in average log weekly wage

	All Education Levels		
	All workers (1)	Male workers (2)	Female workers (3)
	Panel (i): Replication ADH, 2SLS		
$\Delta IPW^{CN,US}$	-0.680***	-0.799***	-0.547**
	(0.245)	(0.284)	(0.227)
	Panel (ii) Supply-Induced 2SLS		
$\widehat{\Delta IPW}^{CN,US}$	-0.596**	-0.801**	-0.355
	(0.293)	(0.351)	(0.265)

Estimations with supply-induced export document similar wage declines for male but no wage declines for female workers.

Part III: Results from adjusted estimation strategy

Wage Changes by Labor Market Segments (II/II)

	College Education		
	Panel (iii): Replication ADH, 2SLS		
$\Delta IPW^{CN,US}$	-0.680**	-0.891**	-0.463*
	(0.300)	(0.362)	(0.267)
	Panel (iv) Supply-Induced 2SLS		
$\widehat{\Delta IPW}^{CN,US}$	-0.641*	-0.923**	-0.355
	(0.362)	(0.452)	(0.320)
	Non College Education		
	Panel (v): Replication ADH, 2SLS		
$\Delta IPW^{CN,US}$	-0.716***	-0.605**	-1.003***
	(0.227)	(0.243)	(0.258)
	Panel (vi) Supply-Induced 2SLS		
$\widehat{\Delta IPW}^{CN,US}$	-0.467*	-0.421	-0.649**
	(0.283)	(0.308)	(0.326)

...and no wage declines for female workers with college education and male workers with no college education.

back

Part III: Results from adjusted estimation strategy

Employment and Wage Changes by Labor Market Segments

Dep Var: Ten-year equivalent changes in log workers, log wage

	Manufacturing Sector			Non-Manufacturing Sector		
	All workers (1)	College (2)	Non-College (3)	All workers (4)	College (5)	Non-College (6)
Employment						
			Panel (i): Replication ADH, 2SL			
$\Delta IPW^{CN,US}$	-3.853***	-3.714***	-4.042***	-0.165	0.370	-0.860
	(1.006)	(1.126)	(1.202)	(0.607)	(0.549)	(0.716)
			Panel (ii) Supply-Induced 2SLS			
$\widehat{\Delta IPW}^{CN,US}$	-4.485***	-4.443***	-4.580***	0.190	0.815	-0.465
	(1.346)	(1.442)	(1.597)	(0.909)	(0.829)	(1.025)
Wage						
			Panel (iii): Replication ADH, 2SL			
$\Delta IPW^{CN,US}$	0.149	0.462	-0.067	-0.651***	-0.649**	-0.692***
	(0.463)	(0.330)	(0.345)	(0.243)	(0.284)	(0.227)
			Panel (iv) Supply-Induced 2SLS			
$\widehat{\Delta IPW}^{CN,US}$	0.471	0.716*	0.290	-0.432	-0.511	-0.303
	(0.542)	(0.374)	(0.453)	(0.299)	(0.344)	(0.296)

All regressions include the full vector of control variables from Column (6) of Table 3. Robust standard errors clustered on the state level in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Muted wage losses are accompanied by strong employment drops.

back