

Multinational Production and Corporate Labor Share

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 - However, the literature has not provided causal evidence of the role of MNEs on the home country LS
- Drawing on a natural experiment, we study the effect of increased MNEs' foreign capacity on the LS

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- Gives a heterogeneous-firm GE model to study firm-level and aggregate LS
 - The model provides how factor prices react to shocks, which directly affects LS
 - It involves the cost savings by offshoring, which is hard to observe in the data
- Estimate relevant elasticity parameters in the production function
 - We relate the home and foreign factor inputs to estimate the elasticity of home-foreign factor substitution
 - Using the estimates, we examine the role of MNEs' foreign productivity on LS

Main Findings

- Corporate LS decreased from '95-'07 in Japan, and more so for large firms
 - Firms operating in flooded areas reduce employment and fixed assets in Japan
- Our “extensive margin hat algebra” solves the measurement difficulty
 - Using the CES production function restriction, we relate the marginal offshorer's cost savings to observable cost shares
- Home labor is estimated relatively more substitutable to foreign inputs than home capital
 - This implies that MNEs' foreign factor productivity growth leads to LS decrease
- During 1995-2016, we find that MNEs' foreign factor productivity growth explains 1.67 pp reduction in LS,
 - Or 10.0% of the observed LS reduction

Literature

- Causes of the labor share decline
 - Factor prices: Karabarbounis, Neiman ('14); Hubmer ('18)
 - Bias in technological change: Elsby, Hobijn, Sahin ('13); Acemoglu, Restrepo ('18); Oberfield, Raval ('21)
 - Market power: Autor, Dorn, Katz, Patterson, Van Reenen ('17a, b); Barkai ('17); De Loecker, Eeckhout ('17); Gouin-Bonfant ('18)
- Among the technological bias, we quantitatively study the role of MNEs
- Home labor market effects of MNEs: Desai, Foley, Hines Jr. ('09); Harrison, McMillan ('11); Ebenstein et al. ('14); Boehm, Flaaen, Pandalai-Nayar ('18); Kovak, Oldenski, Sly ('21)
 - Applying the developed methods, we back out the elasticity of substitution between home and foreign labor
- Solving GE models: Chaney ('08); Dekle et al ('08); Caliendo, Dvorkin, Parro ('19)
 - We provide a new method for solving a heterogeneous-firm GE model

Roadmap

Empirical Evidence

Model

Estimation

Quantitative Exercises

Data

- We combine three datasets
 - Basic Survey of Japanese Business Structure and Activities (BSJBSA)
 - Firm-level survey spanning 1995-2016
 - Includes employment, labor compensation, and accounting variables (e.g. fixed assets) in Japan
 - Basic Study on Oversea Business Activities (BSOBA)
 - Universe of Japan's MNEs and their oversea subsidiaries
 - Contains subsidiary's country-level location, employment, labor compensation
- Orbis BvD for obtaining address-level location of each plant
- Matched by firm names, location, and phone number
 - Match rate is 93.0%
 - Matched data spans years 2007-2016, annually

Measuring Labor Shares (LS)

- Using BSJBSA, we measure corporate labor share (Rognlie, 2018)
 - Labor compensation (wl) is divided by value added, measured by the sum of (wl) and operating surplus
- We then compute micro and macro labor shares by

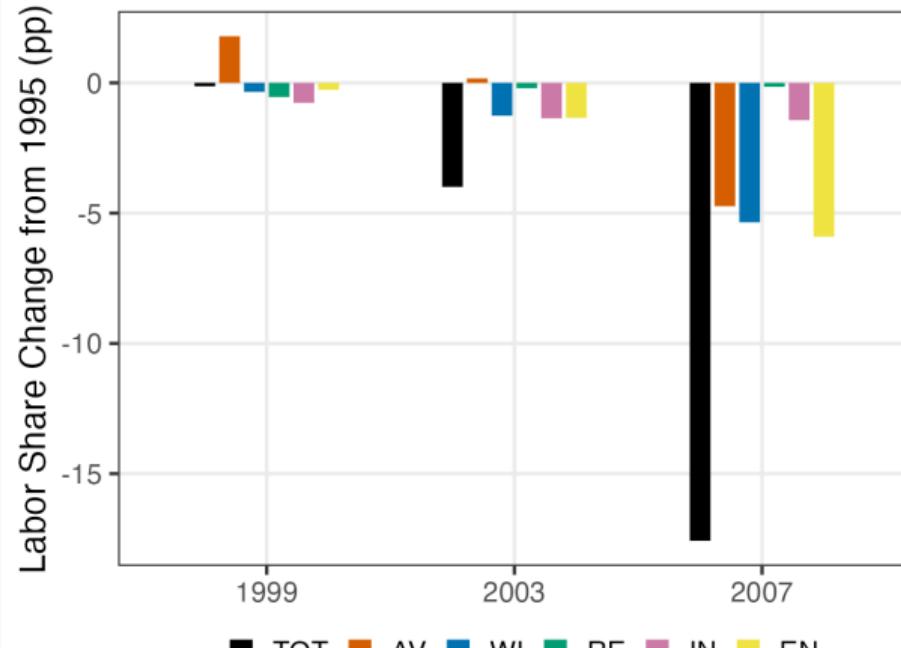
$$s_{it}^L = \frac{(wl)_{it}}{(va)_{it}}, \quad S_t^L = \frac{\sum_i (wl)_{it}}{\sum_i (va)_{it}}$$

- We perform a standard decomposition exercise (Kehrig Vincent, '21)

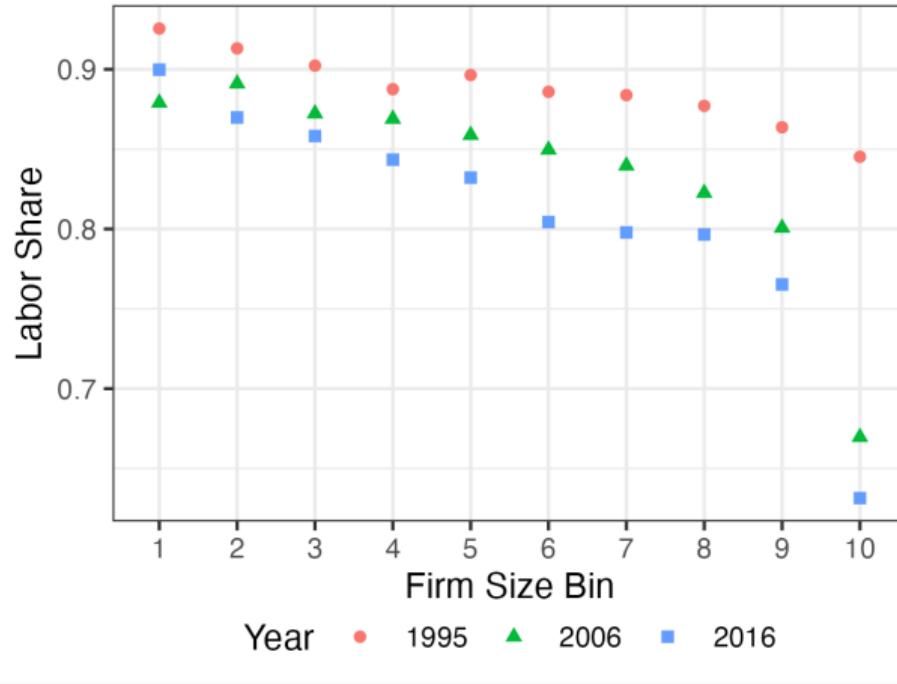
$$\Delta S_t^L = A V_t + \underbrace{\sum_{i \in \Omega_t \cap \Omega_{t_0}} \omega_{it_0} \Delta s_{it}^L}_{\text{Within-firm effect (WI)}} + \underbrace{\sum_{i \in \Omega_t \cap \Omega_{t_0}} s_{it_0}^L \Delta \omega_{it}}_{\text{Reallocation effect (RE)}} + \underbrace{\sum_{i \in \Omega_t \cap \Omega_{t_0}} \Delta \omega_{it} \Delta s_{it}^L}_{\text{Interaction effect (IN)}} + EN_t$$

where $A V_t$ is the average effect and EN_t is the entry-exit and effect [Detail](#)

Decomposition of the Change in Labor Share



Firm Size and Labor Share



Natural experiment: The 2011 Thailand Floods



Source: https://en.wikipedia.org/wiki/2011_Thailand_floods

The Floods as a Foreign Productivity Shock

- The floods are estimated to have \$46.5 billion economic damage
 - This is a world's fourth costliest disaster (World Bank, '11)
 - Although the area is said to be prone to flooding, the scale was unexpected

Balancing check

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- Balancing check
- The floods affected the production side of the economy severely
 - The floods hit manufacturing clusters located in Ayutthaya-Pathum Thani provinces north to Bangkok [Map](#)
 - After the floods, Thailand experienced decrease in exports but not in imports (Benguria Taylor, '19) [Thailand trade trend](#)

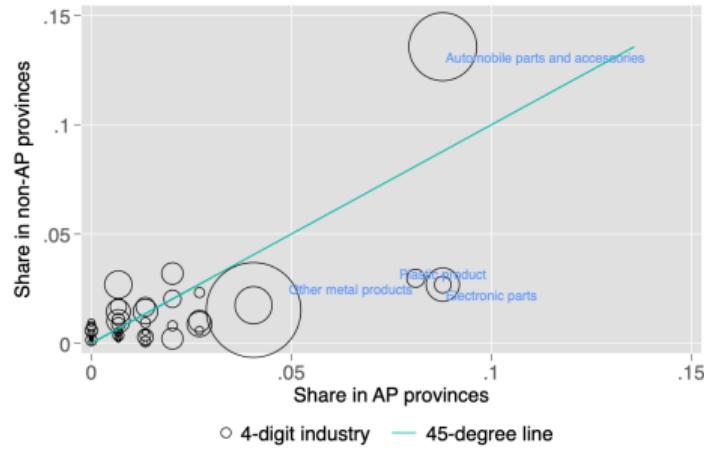
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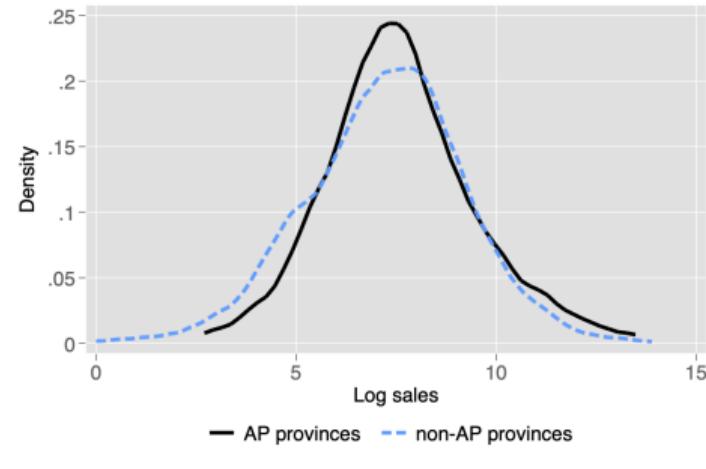
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- The floods effects lasted for more than 5 years [Detail](#)

Balancing Checks



(a) Industry Share



(b) Sales Distribution

- The sales distribution passes the Kolmogorov-Smirnov test ($p = 0.172$)

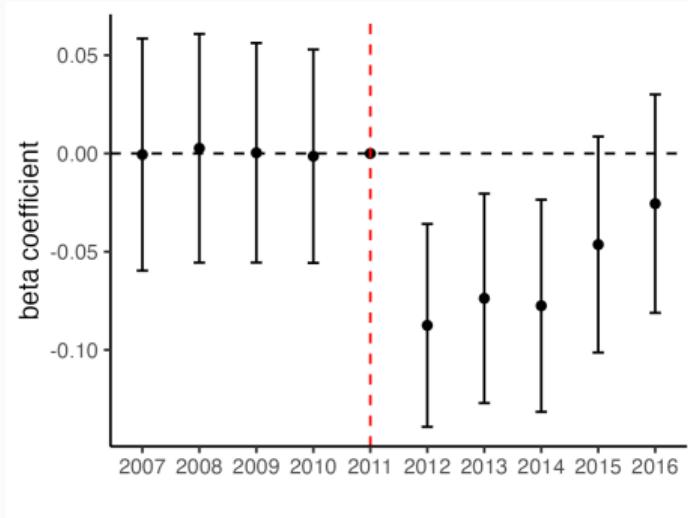
Event Study

- To study the effect of the floods, we select MNEs that have subsidiaries in Thailand
- We classify flooded subsidiaries in Thailand by the flood location
- We first study the subsidiary-level comparison between treated and control groups
- We then run the following headquarter-level event-study regression

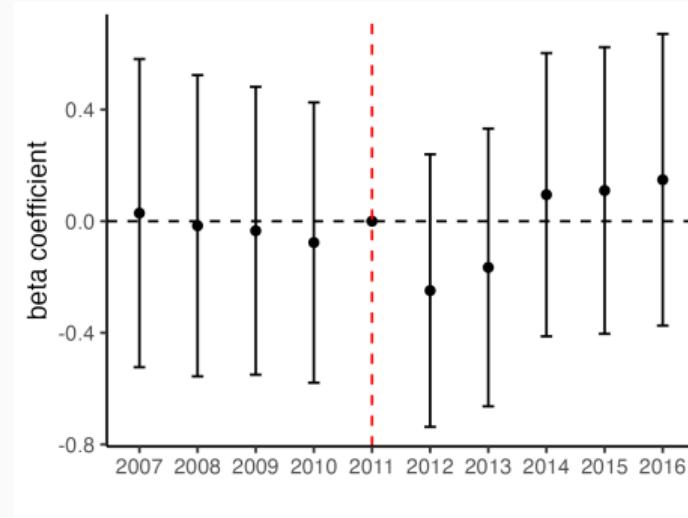
$$y_{it} = \alpha_i + \alpha_t + \sum_{\tau \neq 2011} \beta_\tau Z_i \times \mathbf{1}\{t = \tau\} + \varepsilon_{it},$$

- $Z_i \equiv \frac{\text{sales}_{i,2011}^{\text{flooded}}}{\text{sales}_{i,2011}^{\text{world}}}$ measures the intensity of the shock to the firm i
- β_τ captures the dynamic relative effect of the negative shock due to the floods

Subsidiary-level Results

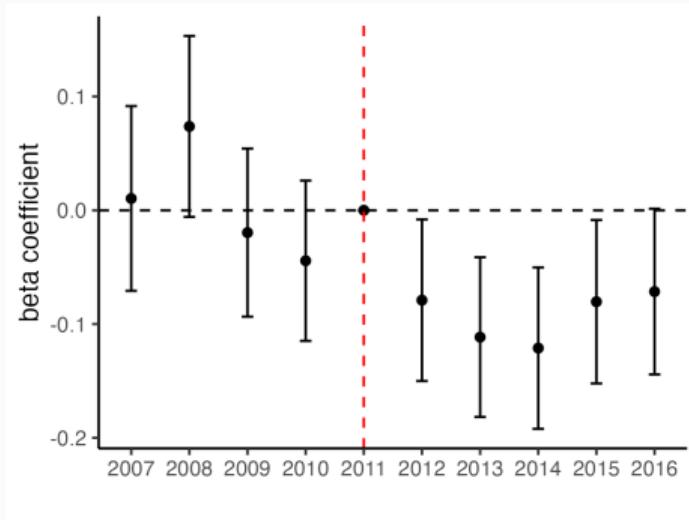
[More Results](#)[Subsample Analysis](#)

(c) Operating Indicator

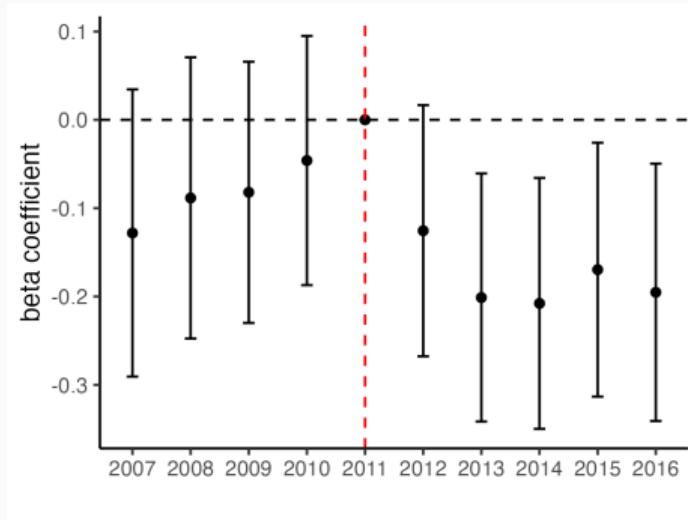


(d) Log Sales

Headquarter-level Results

[Third-country Effects](#)[More Results](#)

(e) Number of Home Employees



(f) Tangible Asset

Summary of Reduced-form Findings

- The Japanese labor share (LS) has been declining between 1995-2007
 - It can be explained by within-firm LS decline and reallocation to low-LS firms
 - Large firms have low LS and the pattern is stronger recently
- Among MNEs, those who invest in Thailand are more productive
- Due to the productivity shock in the Thailand floods:
 - Subsidiaries in the flooded region reduced operation
 - Headquarters reduced home employment and capital stock, with larger decline in capital stock

Roadmap

Empirical Evidence

Model

Estimation

Quantitative Exercises

Overview

- We consider a heterogeneous firms model of offshore subsidiaries
 - The purpose is to study the domestic labor share effect of offshoring
 - For this purpose, we focus on the change in domestic and foreign factor prices reflecting the demand for these factors
- The model features:
 - productivity heterogeneity \Rightarrow between-firm effect on labor share (cf. Draszelski Jaumandreu '19)
 - a nested CES production function \Rightarrow within-firm labor share changes
- We also consider frontier quantitative trade model features, e.g.,
 - sectoral heterogeneity, to allow flexibility of production parameters (Caliendo Parro '15)
 - input-output linkages, to consider the make-or-buy margins parsimoniously (Antras '14)

Environment

- There are S sectors indexed by j
- There are three countries $i \in \mathcal{I} \equiv \{J, T, R\}$
 - J stands for Japan, T for Thailand, and R for the Rest of the World
 - Free trade and no factor mobility between countries
- J and T are small-open
 - Thus, we take sectoral price index P_j and factor price in R as given
 - This excludes feedback that activities in J and T affect world prices
- In J , capital \bar{K}_J and labor \bar{L}_J are supplied inelastically
 - By contrast, there is inelastic factor supply \bar{M}_i in $i = T, R$

Production I: Sectoral Producers and Intermediate Producing Firms in Country J

- Sectoral good producers and intermediate-producing firms operate in J
- Sectoral good producers aggregate intermediate varieties by

$$Q_j \equiv \left[\int_{\omega} (q_j(\omega))^{\frac{\varepsilon_j - 1}{\varepsilon_j}} d\omega \right]^{\frac{\varepsilon_j}{\varepsilon_j - 1}}, \quad \varepsilon_j \geq 0.$$

- Firms produce unique variety ω under monopolistic competition
 - TFP ψ follows Pareto distribution with shape parameter θ_j
- Firms choose offshoring subsidiary location in $i = T, R$ and produces with

$$q_j = f_j(k, m_j^P; \psi) = \psi \left[\alpha_j k^{\frac{\sigma_j - 1}{\sigma_j}} + (1 - \alpha_j) (m_j^P)^{\frac{\sigma_j - 1}{\sigma_j}} \right]^{\frac{\sigma_j}{\sigma_j - 1}}, \quad \sigma_j \geq 0$$

- k : headquarter capital input
- $m_j^P \equiv m_j^P(l, m_T, m_R, m)$: “production input” (up next)

Production II: The Production Input

- The production input is determined by

$$m_j^P(l, m_T, m_R, m) \equiv \left[l^{\frac{\lambda-1}{\lambda}} + (a_T m_T)^{\frac{\lambda-1}{\lambda}} + (a_R m_R)^{\frac{\lambda-1}{\lambda}} + m_j^{\frac{\lambda-1}{\lambda}} \right]^{\frac{\lambda}{\lambda-1}}, \lambda > 1$$

- l : domestic labor input
 - m_i : offshore inputs from subsidiaries in i
 - $m_j \equiv \prod_k m_{kj}^{\delta_{kj}}$: other outsourced inputs in sector j
- a_i represents the exogenous productivity of country $i = T, R$
 - We will study the comparative statics of these changes (floods or globalization)
- Firms in J pay a fixed cost of entry f^E , production f^P , and setting up a subsidiary in location i , f_i^M

Factor Demand in Other Countries and Equilibrium

- In country T , a representative producer uses input M_T with demand function
$$M_T = (p_T^m / A_T)^{-\gamma}$$
- In country R , factor price is given at p_R^m
- In equilibrium, factor prices (w_J, r_J, p_T^m) are determined so that factor markets clear

Marginal Cost and Pricing

- Write D_i as the indicator if a firm enters country $i = T, R$
- A firm's marginal cost depends on the entry decision and offshored inputs

$$c_j = c_j(\psi; D_R, D_T) = \frac{1}{\psi} \left[\alpha_j (r_J)^{1-\sigma_j} + (1 - \alpha_j) \left(p_j^{m,P} \right)^{1-\sigma_j} \right]^{\frac{1}{1-\sigma_j}} \equiv \frac{1}{\psi} \tilde{c}_j(D_R, D_T)$$

where $p_j^{m,P} \equiv p_j^{m,P}(D_R, D_T)$ is the cost of production input

$$p_j^{m,P}(D_R, D_T) = \left(w_J^{1-\lambda} + D_T \left(\frac{p_T^m}{a_T} \right)^{1-\lambda} + D_R \left(\frac{p_R^m}{a_R} \right)^{1-\lambda} + (p_j^m)^{1-\lambda} \right)^{\frac{1}{1-\lambda}}$$

- Given the monopolistic competition, firm prices by $p_j = \frac{\varepsilon_j}{\varepsilon_j - 1} c_j$

Entry Decisions

- Firm ψ enters country i iff $\psi > \psi_{i,j}$
 - We impose parameter restrictions such that $\psi_{T,j} > \psi_{R,j}$ Sales distribution
 - Given this restriction, firms' entry choice is among $d = 00$ (domestic), $d = 01$ (non-Thai international), and $d = 11$ (Thai-investing)
- For instance, threshold $\psi_{d=11,j}$ is given by

$$\pi_j(\psi_{T,j}; d = 11) - \pi_j(\psi_{T,j}; d = 01) = f_T$$

$$\iff \psi_{11,j} = \left(\frac{f_T}{\tilde{\varepsilon}_j P_j^{\varepsilon_j-1} Q_j C S_{11,j}} \right)^{\frac{1}{\varepsilon_j-1}}$$

- $C S_{11,j} \equiv c_j(\psi; d = 11)^{1-\varepsilon_j} - c_j(\psi; d = 01)^{1-\varepsilon_j}$ is the cost-saving term due to entry to Thailand
- Note that $C S_{11,j}$ is a firm-level counterfactual term and is hard to measure

Equilibrium Conditions

- Conditional on optimal entry decision d , firm-level factor demand functions can be derived from the CES formulation
 - Write them as $k_j(\psi; d)$, $l_j(\psi; d)$, and $m_{T,j}(\psi; d)$ Detail
- These firm-level factor demand functions can be integrated over ψ
 - Write them as K^D , L^D , and M_T^D .
- Finally, (w_J, r_J, p_T^m) is the solution to the factor market clearing conditions:

$$K^D = \bar{K}_J, \quad L^D = \bar{L}_J, \quad M_T^D + \left(\frac{p_T^m}{A_T} \right)^{-\gamma} = \bar{M}_T$$

Solving the Equilibrium

- To solve the equilibrium, we follow the “hat algebra” approach (Dekle et al '08)
 - Express all variables x in change, with the hat notation $\hat{x} = x'/x$
- We can show that [Detail](#)

$$\hat{K}^D = \sum_j S_j^K (\hat{r}_J)^{-\sigma_j} \hat{\bar{C}}_j^K$$

$$\hat{\bar{C}}_j^K = \sum_{d \in \{00, 01, 11\}} S_{d,j}^K \left(\hat{\tilde{c}}_{d,j} \right)^{\sigma_j - \varepsilon_j} \hat{s}_{d,j}$$

S_j^K and $S_{d,j}^K$ are cost shares, $\hat{s}_{d,j}$ is offshoring type d 's share change

- Deriving the productivity-controlled cost change $\hat{\tilde{c}}_{d,j}$ is standard
- Similar derivations for \hat{L}^D and \hat{M}_T^D
- Pareto assumption implies $\hat{s}_{d,j}$ depends on the cost-savings change $\hat{CS}_{d,j}$. E.g.,

$$\hat{s}_{11,j} = \left(\hat{\psi}_{11,j} \right)^{-(\theta_j - (\varepsilon_j - \sigma_j))} = \left(\hat{CS}_{11,j} \right)^{-\frac{\theta_j - (\varepsilon_j - \sigma_j)}{\varepsilon_j - 1}}$$

Extensive Margin Hat Algebra (EMHA)

- $\hat{CS}_{d,j}$ involves unobservable *counterfactual* marginal costs
 - To overcome this difficulty, we propose the EMHA
- The CES restriction implies the cost ratio ($CR_{11,j} \equiv (c_{11,j}/c_{01,j})^{1-\varepsilon_j} - 1$) as follows:

$$\begin{aligned} CS_{11,j} &= c_{11,j}^{1-\varepsilon_j} - c_{01,j}^{1-\varepsilon_j} = c_{01,j}^{1-\varepsilon_j} \left[(c_{11,j}/c_{01,j})^{1-\varepsilon_j} - 1 \right] \\ &= c_{01,j}^{1-\varepsilon_j} \left\{ \left[s_{01,j}^K + (1 - s_{01,j}^K) \left(1 - s_{11,j}^{m_T|m^P} \right)^{-\frac{1-\sigma_j}{1-\lambda}} \right]^{\frac{1-\varepsilon_j}{1-\sigma_j}} - 1 \right\} \end{aligned}$$

where $s_{01,j}^K$ and $s_{11,j}^{m_T|m^P}$ are the factor cost shares Detail

- These shares can be observed *before and after* the change
- Hence, the change in the cost saving is

$$\hat{CS}_{11,j} = \underbrace{(\hat{c}_{01,j})^{1-\varepsilon_j}}_{\text{observed}} \quad \underbrace{(CR'_{11,j}/CR_{11,j})}_{\text{change}}$$

Roadmap

Empirical Evidence

Model

Estimation

Quantitative Exercises

Calibration

- To solve the EMHA conditions, we need a set of parameters $(\theta_j, \varepsilon_j, \sigma_j, \lambda)$
 - We calibrate $(\theta_j, \varepsilon_j, \sigma_j)$ by applying methods in the literature
 - We then follow the MNE-employment literature to estimate the remaining parameter
- Calibration of sectoral parameters
 - θ_j (Pareto shape parameter): fitted to the sectoral tail sales distribution
 - ε_j (Demand elasticity): fitted to the sectoral average markups
 - σ_j (Capital-production input elasticity): fitted to the relative capital demand with respect to local wage (Oberfield, Raval '21) [detail](#)

Calibration Results

Code	Label	θ_j	ε_j	σ_j
9	Food	6.57	3.76	0.23
11	Textile	13.58	4.99	0.57
15	Wood	6.17	4.15	0.19
16	Chemical	5.93	2.73	0.22
18	Plastic	10.29	4.62	0.23
19	Rubber	19.78	3.85	0.03
21	Ceramics	4.68	3.07	0.32
22	Metal	7.57	4.38	0.28
23	Non-ferrous Metal	53.2	5.48	0.01
24	Metal Product	8.56	4.1	0.21
25	General Machine	7.45	4.71	0.07
28	Electronics	8.03	4.7	0.22
29	Electric Machine	8.86	4.85	0.36
30	ICT Machine	8.03	4.7	0.22
31	Transportation Machine	8.2	5.35	0.19
32	Other Manufacturing	5.79	4.77	0.4

- Calibrated parameters satisfy restrictions of Pareto distribution θ_j

Estimating Production Input Substitutability λ

- Focus on a sample of MNEs that have subsidiaries in Thailand
- We follow a D-in-D 2SLS specification: (Kovak, Oldenski, Sly '21)

$$\ln(l_{it}) = a_i + a_t + b \ln(m_{it}^T) + e_{it},$$

- The flood shock IV for the D-in-D regression is $Z_{it} \equiv Z_i \times \mathbf{1}\{t \geq 2012\}$
- The estimator of b using Z_{it} converges to $E\left[\frac{d \ln l_{it}/dZ_{it}}{d \ln m_{it}^T/dZ_{it}}\right]$

Main Regression Results

VARIABLES	(1) $\ln l_{it}^{JPN}$	(2) $\ln l_{it}^{JPN}$	(3) $\ln l_{it}^{JPN}$	(4) $\ln m_{it}^T$	(5) $\ln l_{it}^{JPN}$
$\ln m_{it}^T$	0.446*** (0.00686)	0.0604*** (0.0106)	0.192*** (0.0502)		
Z_{it}				-0.728*** (0.108)	-0.140*** (0.0367)
Observations	5,563	5,563	5,563	5,563	5,563
Model	OLS	FE	2SLS	2SLS-1st	2SLS-reduced
Firm FE	-	YES	YES	YES	YES
Year FE	-	YES	YES	YES	YES

Notes: Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

- The positive 2SLS result is consistent with the literature
- Robustness: other foreign factor measures, extensive-margin IV, different control groups
- Extension: regression by industry

Implied Substitutability λ

- Using our nested-CES specification, we can show that

$$E \left[\frac{d \ln l_{it} / dZ_{it}}{d \ln m_{it}^T / dZ_{it}} \right] = \frac{\sum_j S_j^L s_{T,j}^{m_T|m^P} [(\lambda - \sigma_j) + (\sigma_j - \varepsilon_j) s_{T,j}^{m^P}]}{-\lambda + \sum_j S_j^{M_T} s_{T,j}^{m_T|m^P} [(\lambda - \sigma_j) + (\sigma_j - \varepsilon_j) s_{T,j}^{m^P}]}.$$

- $d \ln l_{it} / dZ_{it}$ comes solely from the inflated cost index
- $d \ln m_{it}^T / dZ_{it}$ comes from the inflated cost index and direct substitution
- The method of moments implies $\lambda = 1.40$ with s.e. 0.133 standard error
- In all industries, we have $\lambda > \sigma_j$
 - Hence, labor is relative substitute of foreign inputs
 - An increase in the factor-augmenting productivity shock in the foreign country implies lower labor share in Japan

Roadmap

Empirical Evidence

Model

Estimation

Quantitative Exercises

Model Fit

- We simulate firms and examine if the model can predict data patterns
- Procedure
 1. Hit productivity shock $\hat{a}_T = 0.1$ to firms operating in Ayutthaya-Pathum Thani (AP) provinces
 2. Solve the EMHA to get $(\hat{r}_J, \hat{w}_J, \hat{p}_T^M)$
 3. Obtain model-predicted change in employment $\hat{l}(\omega)$ and capital $\hat{k}(\omega)$
 4. Regress $\hat{l}(\omega)$ and capital $\hat{k}(\omega)$ on AP dummy

	Employment		Capital	
	Model	Data	Model	Data
	(1)	(2)	(3)	(4)
Shocked (AP)	-0.032*** (0.002)	-0.038* (0.021)	-0.056*** (0.003)	-0.048*** (0.012)
N of firms	595	595	595	595

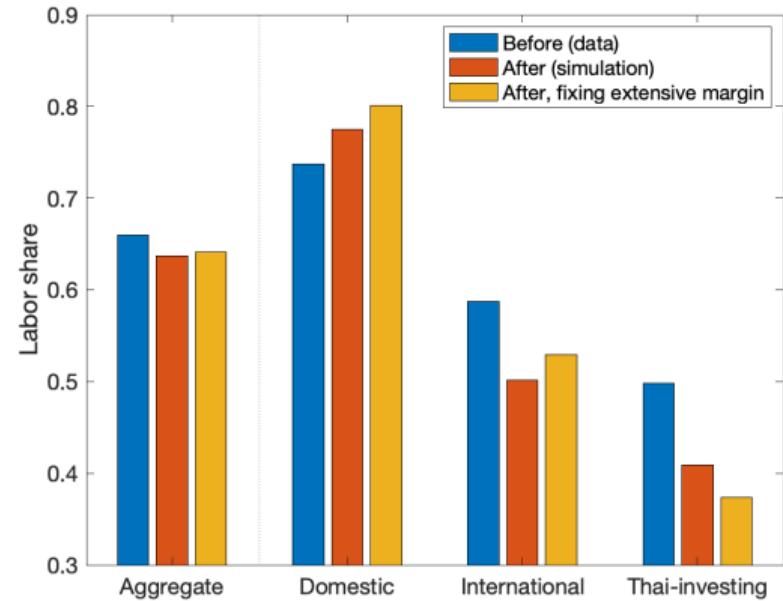
Quantifying the Role of Foreign Productivity Growth

- To study how labor share implications differ across firms' globalization strategy, compute the labor share of firm groups S_d^L
 - E.g., the labor share of Thai-investors is

$$S_{11}^L = \frac{\sum_j \int_{\psi_{T,j}}^{\infty} w_J l_j(\psi) dG_j(\psi)}{\sum_j \int_{\psi_{T,j}}^{\infty} \frac{\varepsilon_j}{\varepsilon_j - 1} [w_J l_j(\psi) + r_J k_j(\psi)] dG_j(\psi)}$$

- Also, to obtain the effect fixing selection, we did the following exercise
 1. Solve the EHMA $(\hat{r}_J, \hat{w}_J, \hat{p}_T^M)$ with exogenously set $\hat{\psi}_{T,j} = \hat{\psi}_{R,j} = 1$
 2. Compute \hat{S}_d^L with $(\hat{r}_J, \hat{w}_J, \hat{p}_T^M)$ and $\hat{\psi}_{T,j} = \hat{\psi}_{R,j} = 1$

Simulation Results



- The aggregate change explains 10.0% of observed decline in 1995-2016

- To consider welfare, we need to introduce a consumer
 - Suppose, for simplicity, there is a representative consumer in J
- In our small-open setting, the welfare change can be measured by the nominal income change
- Between 1995 and 2016, we can compute the changes in national income

$$\hat{GDP}_J = (r_J K + \hat{w}_J L) = 5.2\%$$

$$\hat{GNI}_J = (r_J K + w_J L + \hat{p}_T^M M_T + p_R^M M_R) = 5.3\%$$

or 0.2% annually

Summary

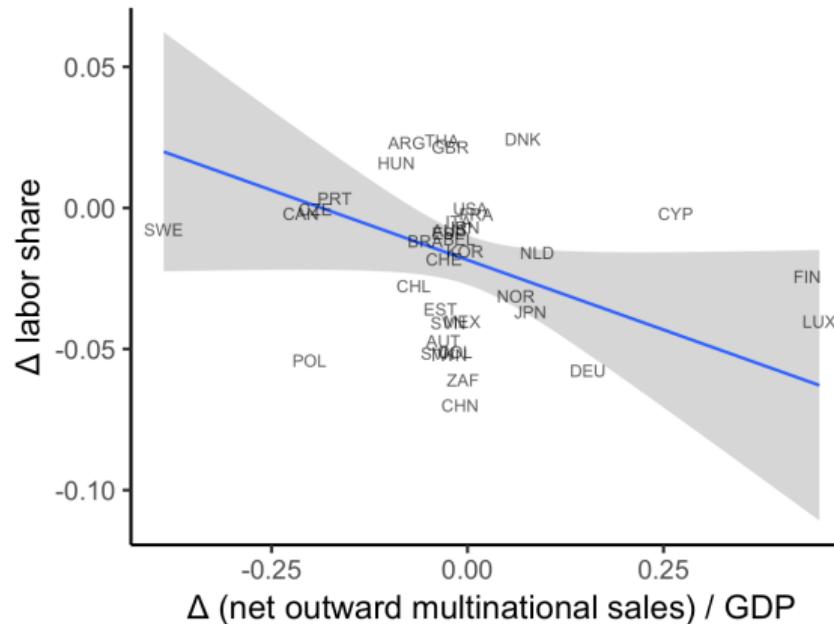
- We study how MNEs contribute to the decrease in the home-country's labor share
- Our empirical results show that firms affected by the flood decreased both employment and profit, with stronger effects on profit
- We provide a heterogeneous-firm model with multiple factor inputs and the extensive margin hat algebra to solve such a model
- Our estimated model implies that 1.67 pp decline in the labor share can be explained by the foreign factor productivity growth

Roadmap

Backup

First-pass: Cross-country Net MNE Sales and Labor Share

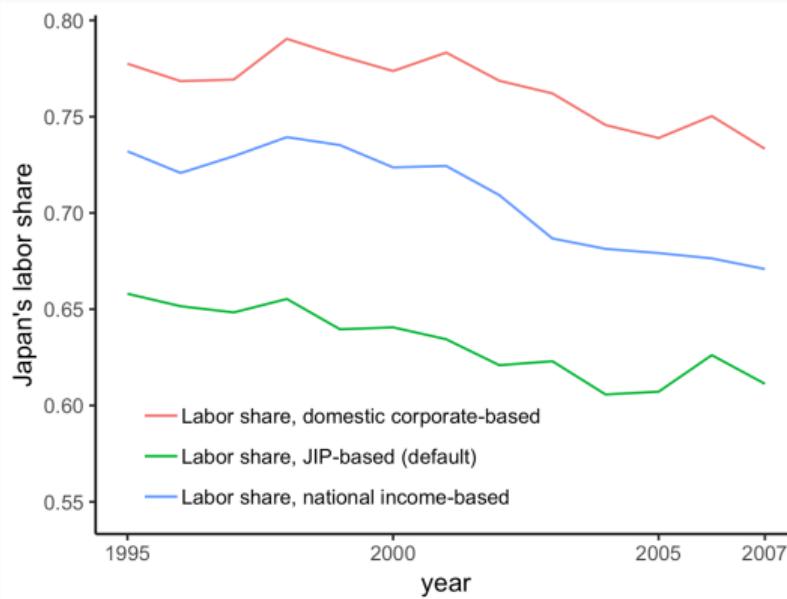
Back



Note: Authors' calculation based on Karabarbounis Neiman (2014) and UNCTAD. The horizontal axis is the change in the sum of bilateral net outward multinational sales between 1991-1995 average and 1996-2000 average. The vertical axis is the change in labor share from 1991 to 2000. Singapore is dropped because it has an outlier value for the outward multinational sales measure.

Other Labor Share Measures

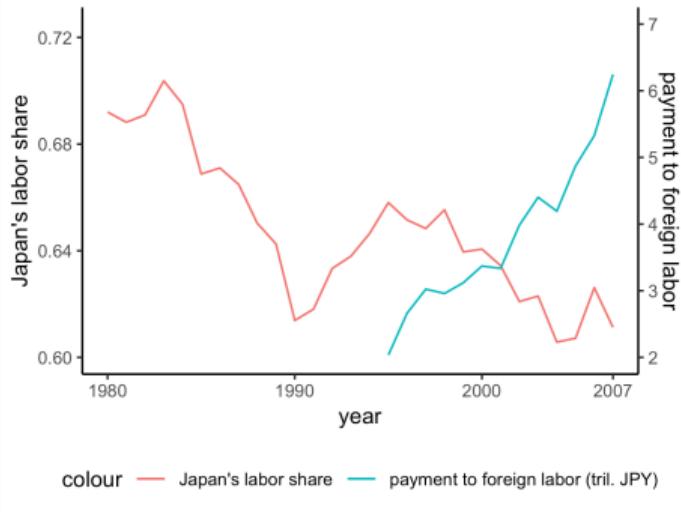
[go back](#)



Source: Authors' calculation based on Japan Industrial Productivity (JIP) Database 2015, Cabinet Office Long-run Economic Statistics (COLES, https://www5.cao.go.jp/j-j/wp/wp-je12/h10_data01.html, accessed on May 13, 2019), and Japan's SNA, Generation of Income Account, 2009. JIP-based labor share is calculated by the share of nominal labor cost in nominal value added of JIP market economies. National income-based labor share is the fraction of nominal employee compensations over nominal national income from COLES. Domestic corporate-based labor share is net labor share of domestic corporate factor income, calculated from the SNA, by the fraction of the item "Wages and salaries" over the sum of "Wages and salaries" and "Operating surplus, net."

Japan's LS and MNEs' Foreign Labor Compensation

Back



Source: Authors' calculation based on Japan Industrial Productivity (JIP) Database 2015 and Survey of Oversea Business Activity (SOBA) 1996-2008. The labor share is calculated by the share of nominal labor cost in nominal value added of JIP market economies. The payment to offshore labor is the sum of worker compensation to foreign subsidiaries of all Japanese multinational corporations in SOBA.

Cross-country Evidence

Other definitions of LS

Other measures of MNEs

MNEs versus non-MNEs

Average and entry-exit effects

Back

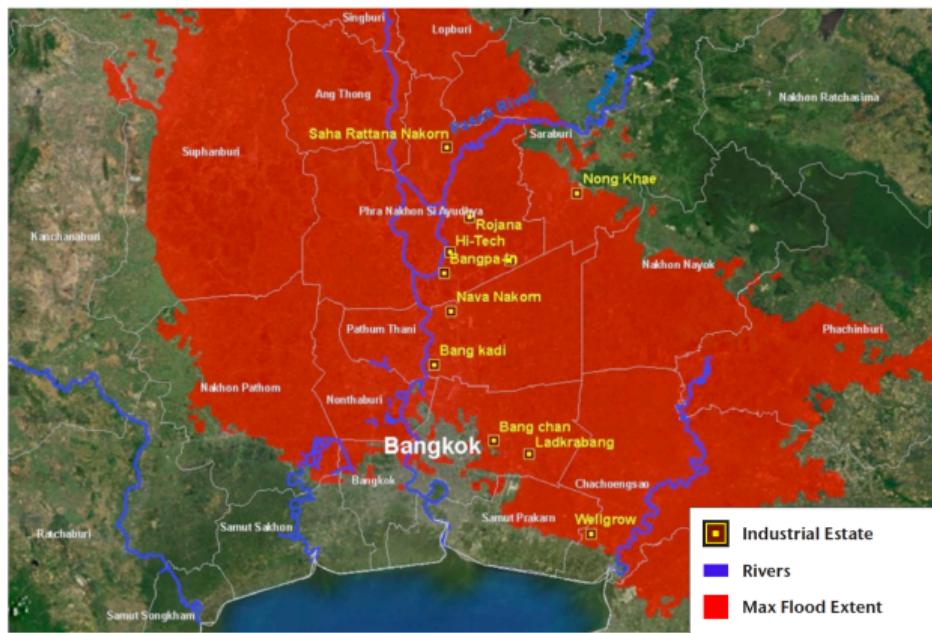
$$AV_t \equiv \left(\sum_{i \in \Omega_t} \frac{s_{it}^L}{|\Omega_t|} - \sum_{i \in \Omega_{t_0}} \frac{s_{it_0}^L}{|\Omega_{t_0}|} \right)$$

$$EN_t \equiv \left(\sum_{i \in \Omega_t \setminus \Omega_{t_0}} \omega_{it} s_{it}^L - \sum_{i \in \Omega_{t_0} \setminus \Omega_t} \omega_{it_0} s_{it_0}^L \right)$$

Flood Map

[back](#)

Exhibit 16: Selected Industrial Estates Embedded within the Maximum Flood Extent on November 15, 2011

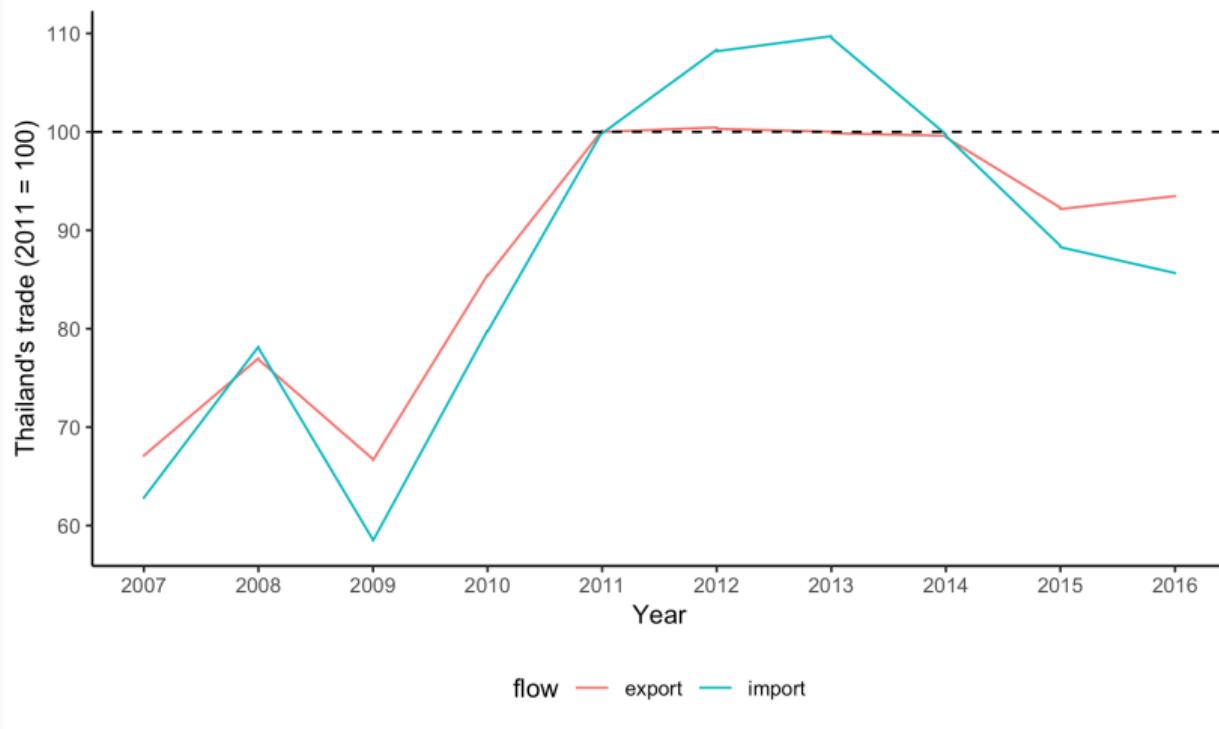


Source: GISTDA

Source: AON Benfield (2012) http://thoughtleadership.aonbenfield.com/Documents/20120314_impact_forecasting_thailand_flood_event_recap.pdf

Trend of Thailand's Trade

[back](#)

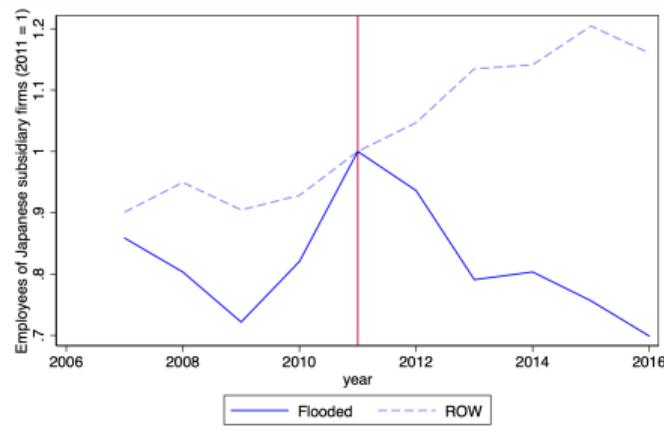


Source: Comtrade

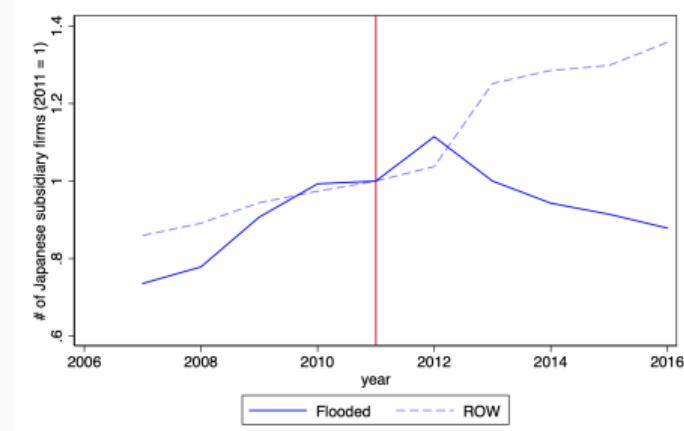
The Floods and Aggregate Trends

[back](#)

- Companies “move to avoid potential supply chain disruptions.” (Nikkei Asian Review, '14)



(g) Total employment

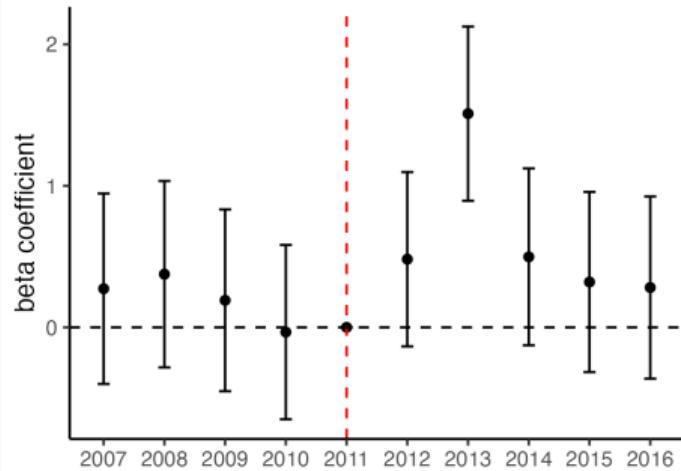


(h) Number of subsidiaries

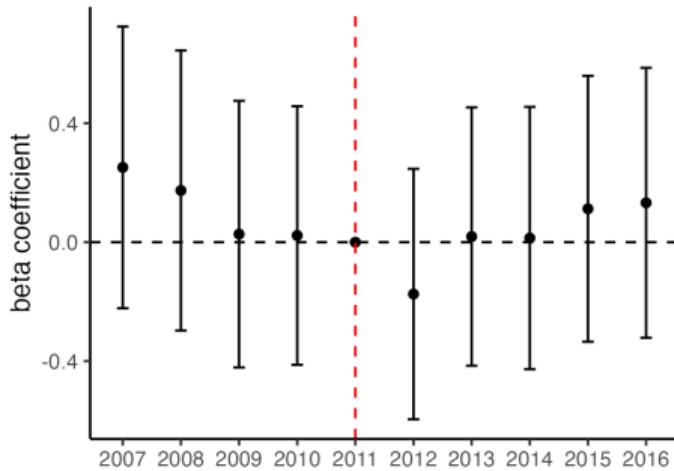
Note: Authors' calculation from SOBA 2007-2016. "Flooded" shows the evolution of total employment in plants located in the flooded area (Ayutthaya and Pathum Thani Province). "ROW" shows that out of the flooded area. Both trends are normalized to 1 in 2011.

More Subsidiary-level Results

[Back](#)



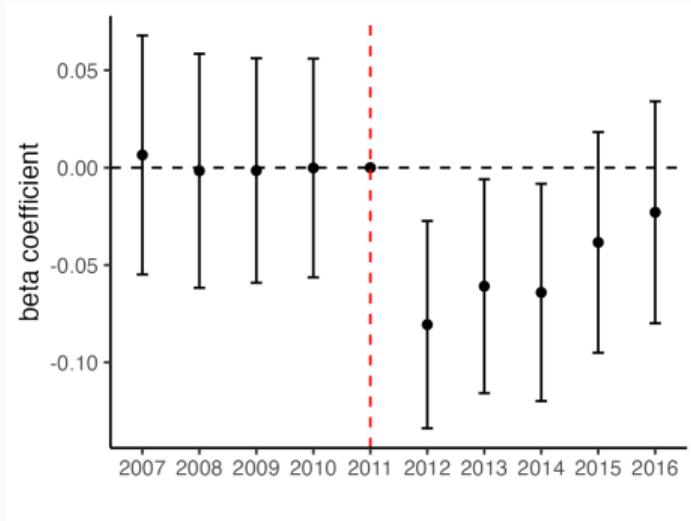
(i) Log Investment



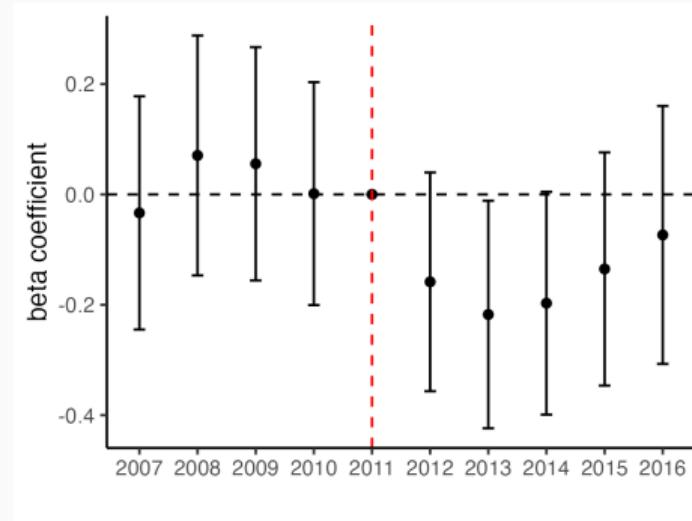
(j) Log Employment

Subsample Analysis – Children or Grandchildren

Back



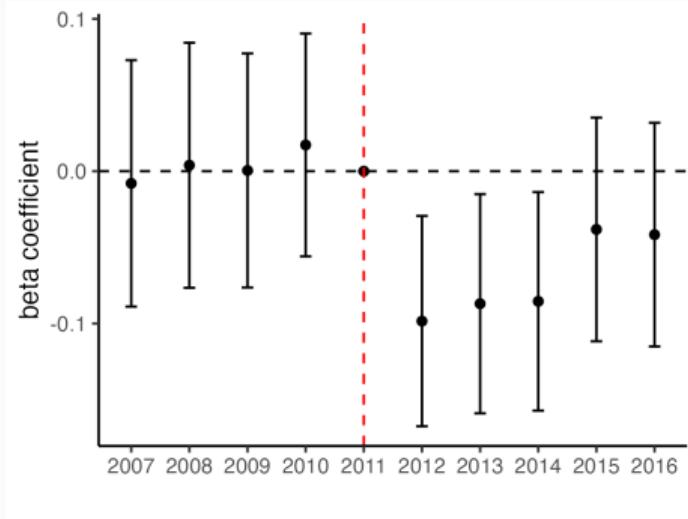
(k) Children



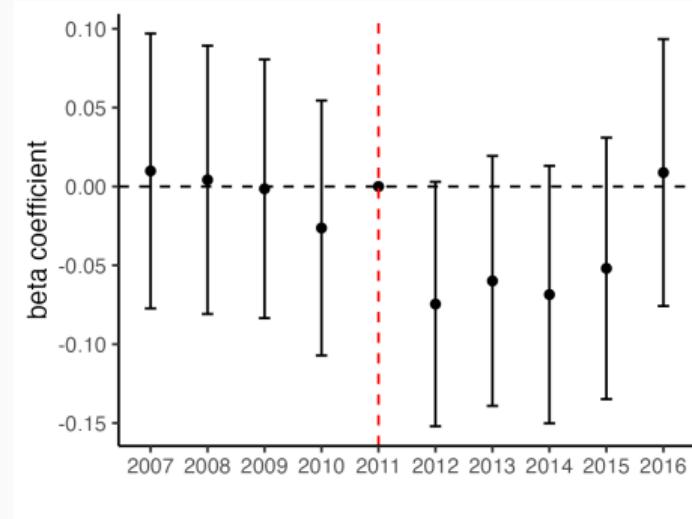
(l) Grandchildren

Subsample Analysis – Ownership Levels

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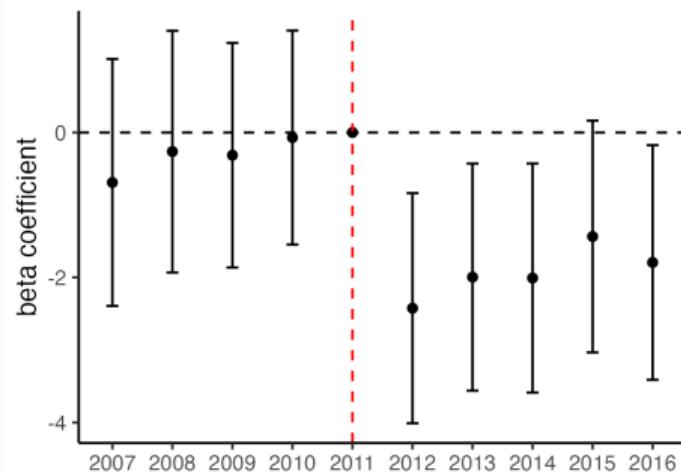
(m) 100% Ownership



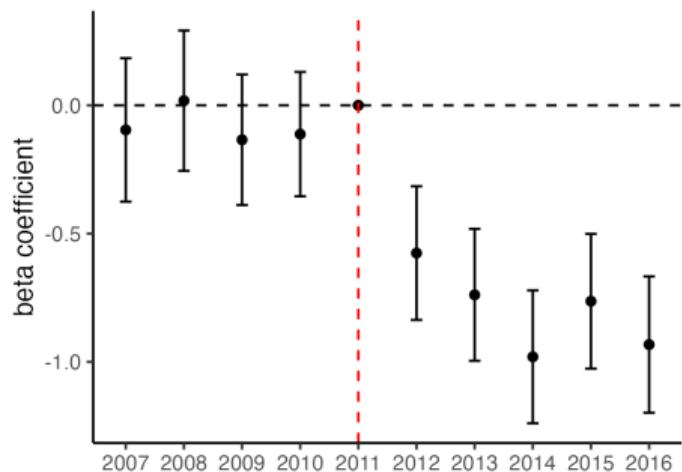
(n) Less than 100% Ownership

Headquarter-level Results on RoW Activities

Back



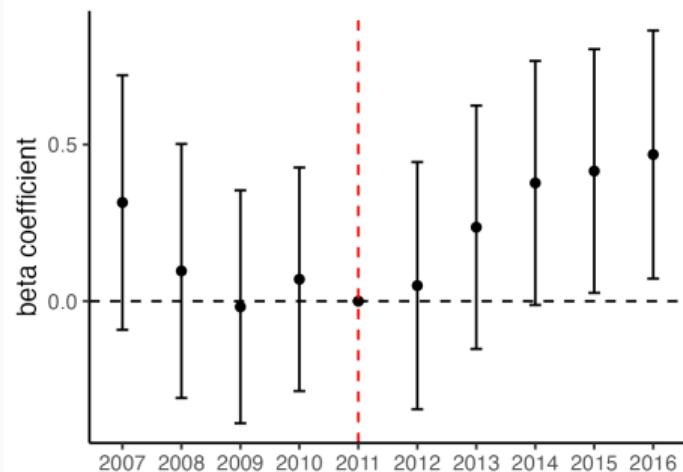
(o) Non-Thai Foreign Subsidiaries



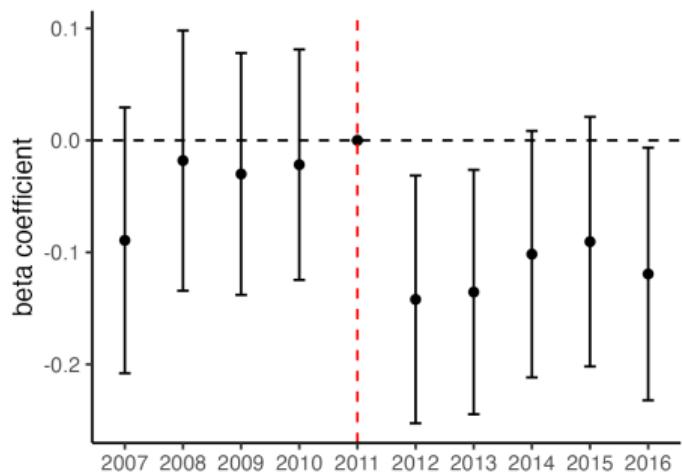
(p) Non-Thai Foreign total employment

Further Headquarter-level Results

Back



(q) Number of Non-regular Employees

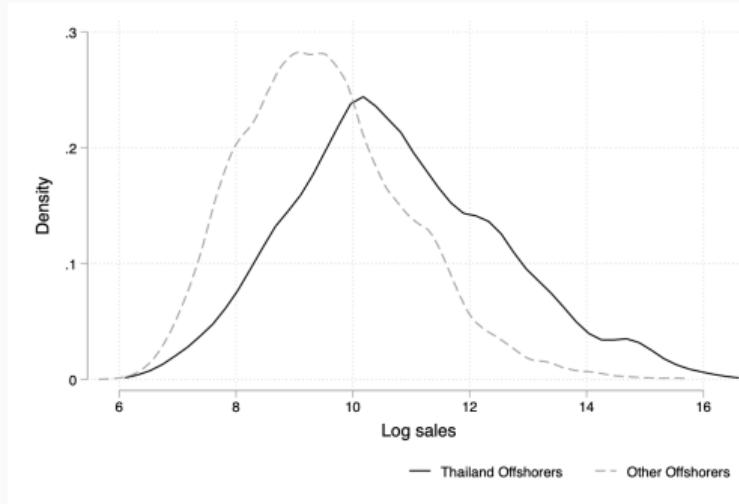


(r) Fixed Asset

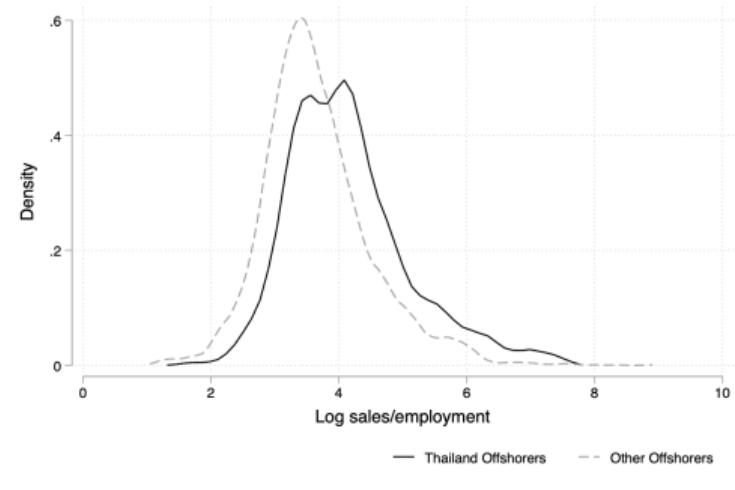
Thai Investors Sales Distribution vis-a-vis Other MNEs

Back

- Thai investors are more productive than non-Thai investors



(s) Log Sales



(t) Log Sales per Employment

CES factor demands

Back

$$r_J k_j(\psi; d^*) = \left(\frac{r_J}{c_j^*} \right)^{1-\sigma_j} \left(\frac{\varepsilon_j}{\varepsilon_j - 1} \right)^{1-\varepsilon_j} (c_j^*)^{1-\varepsilon_j} P_j^{\varepsilon_j-1} Q_j$$

$$w_J l_j(\psi; d^*) = \left(\frac{w_J}{p_j^{m,P_*}} \right)^{1-\lambda} \left(\frac{p_j^{m,P_*}}{c_j^*} \right)^{1-\sigma_s} \left(\frac{\varepsilon_j}{\varepsilon_j - 1} \right)^{1-\varepsilon_j} (c_j^*)^{1-\varepsilon_j} P_j^{\varepsilon_j-1} Q_j$$

$$p_T^m m_{T,j}(\psi; d^*) = \left(\frac{p_T^m / a_T}{p_j^{m,P_*}} \right)^{1-\lambda} \left(\frac{p_j^{m,P_*}}{c_j^*} \right)^{1-\sigma_j} \left(\frac{\varepsilon_j}{\varepsilon_j - 1} \right)^{1-\varepsilon_j} (c_j^*)^{1-\varepsilon_j} P_j^{\varepsilon_j-1} Q_j$$

where $c_j^* \equiv c_j(\psi; d^*)$ and $p_j^{m,P_*} \equiv p_j^{m,P}(d^*)$

Change in the price of production input

Back

$$d \ln \left(p_j^{m,P} \right) = s^L d \ln w + s_T^m (d \ln p_T^m - d \ln a_T) - s_R^m d \ln a_R$$

where s^L , s_T^m , and s_R^m are the shares of domestic labor, subsidiary input from T and R , respectively

Change in threshold

Back

$$d \ln \psi_{i,j}(\alpha) \equiv s^K(\alpha) d \ln r_J + (1 - s^K(\alpha)) \Delta d \ln p_j^{m,P}$$

where

$$\begin{aligned} \Delta d \ln p_j^{m,P} &\equiv \left(\frac{c_j(\psi_{T,j}(\alpha), \alpha; 1, D_R)}{CS_j(\alpha)} \right)^{1-\varepsilon_j} d \ln p_j^{m,P}(1, D_R) \\ &\quad - \left(\frac{c_j(\psi_{T,j}(\alpha), \alpha; 0, D_R)}{CS_j(\alpha)} \right)^{1-\varepsilon_j} d \ln p_j^{m,P}(0, D_R) \end{aligned}$$

Initial Cost Shares (Aggregate)

Back

$$S_j^K = \frac{r_J K_j}{\sum_k r_J K_k}, \quad S_j^L = \frac{w_J L_j}{\sum_k w_J L_k}, \quad S_j^{M_T} = \frac{p_T^m M_{T,j}}{\sum_k p_T^m M_{T,k}},$$

$$S_j^K(d) = \frac{\int_{\psi \in d} r_J k_j(\psi) dG_j(\psi)}{r_J K_j}, \quad S_j^L(d) = \frac{\int_{\psi \in d} w_J l_j(\psi) d\psi}{w_J L_j}$$

Initial Cost Shares across Factors

Back

$$s_{d,j}^K = \frac{\int_{\psi \in d} r_J k_j(\psi) d\psi}{\int_{\psi \in d} c_j q_j(\psi) d\psi}, \quad s_{d,j}^{m_T|m^P} = \frac{\int_{\psi \in d} p_T^m m_{T,j}(\psi) d\psi}{\int_{\psi \in d} p^{m,P} m^P(\psi) d\psi}$$

- By the first order condition, we can show

$$\ln(rK/p^M M) = (\sigma - 1) \ln(w/r) + \text{const.}$$

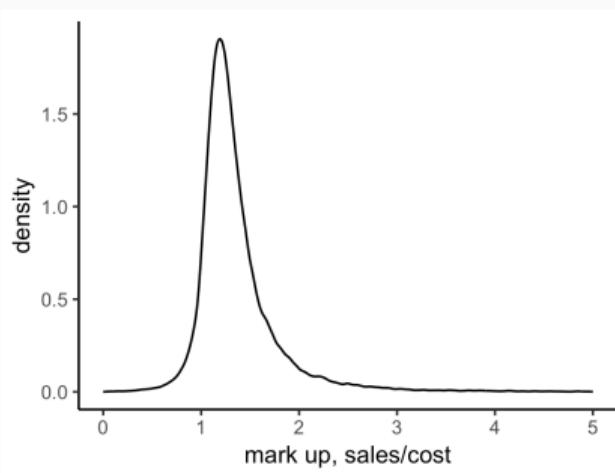
- Oberfield-Raval uses the location $m(i)$ -level variation to estimate

$$\ln(rK/p^M M)_i = b_0 + b_1 \ln(w_{m(i)}) + X_i b_2 + \varepsilon_i,$$

with a shift-share instrument $z_{m,t} = \sum_{j \in \mathcal{J}^{NM}} \omega_{mj,t-10} g_{jt}$.

Demand Elasticity ε with Census of Manufacture, Japan

- Following OR, $\varepsilon = m / (m - 1)$, where $m \equiv \text{sales}/\text{cost}$ is the measured markup.
- The average markup implies $\varepsilon \in [3.98, 4.88]$, depending on the treatment of extreme values. [go back](#)



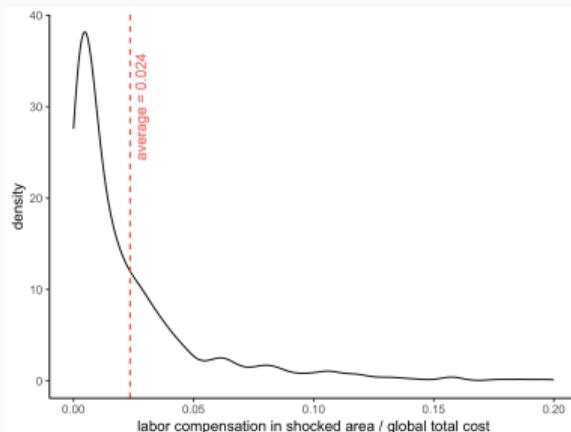
Source: Census of Manufactur, 1997. Estimates are obtained from inverting the markup, following Oberfield and Raval (2014). The markup is defined as sales divided by the sum of costs from capital, labor, and materials.

Share of Foreign Labor Cost in Total Cost s^F

[go back](#)

- To calculate s^F , we focus on firms located in the flooded region.
- We then calculate, for each headquarter firm f ,

$$s_f^F = \frac{\sum_{l \in \text{treated}} \text{total payroll}_{f, 2011}^l}{\sum_{l \in \text{world}} \text{total cost}_{f, 2011}^l}.$$



Note: Global total cost is calculated by the sum of domestic cost and multinational cost. The domestic cost is the sum of the following items: advertising expense, information processing communication cost, mobile real estate rent, packing and transportation costs, total payroll, depreciation expense, welfare expense, taxes, interest expense, and lease payments. The international cost is the sum of each subsidiaries total

Other Measures of Foreign Factors

[go back](#)

- Measure the value added by

$$VA_{it}^{ROW} = \sum_{s \in i} (sales_{st} - purchases_{st}).$$

- Regress

$$\ln(l_{it}^{JPN}) = a_i^{VA} + a_t^{VA} + b^{VA} \ln(VA_{it}^{ROW}) + e_{it}^{VA}.$$

VARIABLES	(1) $\ln VA_{it}^{ROW}$	(2) $\ln l_{it}^{JPN}$	(3) $\ln l_{it}^{JPN}$	(4) $\ln sales_{it}^{ROW}$	(5) $\ln l_{it}^{JPN}$
Z_{it}	-0.762*** (0.105)	-0.132*** (0.0374)		-0.549*** (0.0849)	
$\ln(VA_{it}^{ROW})$			0.173*** (0.0494)		
$\ln(sales_{it}^{ROW})$				0.240*** (0.0685)	
Observations	5,460	5,460	5,460	5,460	5,460
Model	2SLS-1st	2SLS-reduced	2SLS	2SLS-1st	2SLS
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses

Extensive Margin

[go back](#)

- Alternative extensive-margin instrument

$$Z_{it}^{EXT} = \mathbf{1} \left\{ L_{i,2011}^{treated} > 0 \cap t \geq 2012 \right\}.$$

- Idea: did firms located in the flooded region change the employment relative to those in other regions?

VARIABLES	(1) $\ln l_{it}^{JPN}$	(2) $\ln l_{it}^{JPN}$
$\ln l_{it}^{ROW}$	0.284*** (0.00394)	0.0271*** (0.00435)
Observations	22,795	22,795
Model	OLS	FE
Firm FE	-	YES
Year FE	-	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Sample Selection

[go back](#)

- Firms in the flooded region are affected. To which firms should we compare?
- Different control groups
 - all firms in Japan
 - all firms in Japan with Bartik specification (Desai et al. 2009)

VARIABLES	(1) extensive	(2) intensive	(3) extensive	(4) intensive
shock	-0.0497*** (0.0126)	-0.172*** (0.0667)	-0.0490*** (0.0139)	-0.249*** (0.0774)
Observations	185,703	185,703	91,690	91,690
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Balanced panel?			YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Regression by Industries

[go back](#)

- Estimates with the intensive margin instrument.

VARIABLES	(1) 2SLS	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS	(6) 2SLS
Log Subsidiary Employment	0.120** (0.0501)	-0.00447 (0.610)	0.168*** (0.0486)	0.0774 (0.0694)	-0.184 (0.162)	0.507* (0.292)
Observations	3,704	773	540	563	521	915
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry	manuf	chem	metal	machine	elec	auto

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[1st stage and reduced form](#)

By Industries, 1st Stage

[go back](#)

- Estimates with the intensive margin instrument.

VARIABLES	(1) 1st	(2) 1st	(3) 1st	(4) 1st	(5) 1st	(6) 1st
Thai Flood Shock	-0.730*** (0.169)	-0.152 (0.173)	-1.655*** (0.358)	-2.223** (1.101)	-0.655*** (0.161)	-0.303** (0.132)
Observations	3,704	773	540	563	521	915
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry	manuf	chem	metal	machine	elec	auto

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

By Industries, Reduced Form

[go back](#)

- Estimates with the intensive margin instrument.

VARIABLES	(1) reduced	(2) reduced	(3) reduced	(4) reduced	(5) reduced	(6) reduced
Thai Flood Shock	-0.0874** (0.0428)	0.000677 (0.0923)	-0.277*** (0.0594)	-0.172 (0.225)	0.120 (0.105)	-0.154** (0.0700)
Observations	3,704	773	540	563	521	915
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry	manuf	chem	metal	machine	elec	auto

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Delta Method for $se(\hat{\lambda})$

[go back](#)

- Note

$$\hat{b} = \frac{\varepsilon s_0^F}{\hat{\lambda} - 1 + \varepsilon s_0^F} \Leftrightarrow \hat{\lambda} = \frac{\varepsilon s_0^F}{\hat{b}} + 1 - \varepsilon s_0^F.$$

- If \hat{b} satisfies $\sqrt{n}(\hat{b} - b_0) \rightarrow_d N(0, \Sigma)$, then by the delta method we have

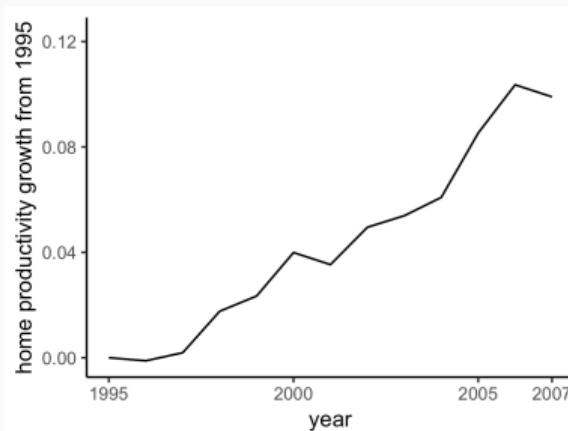
$$\sqrt{n}(\hat{\lambda} - \lambda_0) \rightarrow_d N\left(0, \left(\frac{\varepsilon s_0^F}{b_0^2}\right)^2 \Sigma\right).$$

- In our case $se(\hat{\lambda}) = \frac{\hat{\varepsilon} s_0^F}{\hat{b}^2} \sqrt{\hat{\Sigma}} = \frac{4 \times 0.024}{(0.19)^2} \times 0.05 \approx 0.133$
- $\hat{\lambda} = 1.40 \Rightarrow$ Test $H_0 : \lambda_0 = 1$ gives $t = 0.40/0.133 \approx 3.008$.

Japan's Labor Productivity $d \ln a_t^L$

[go back](#)

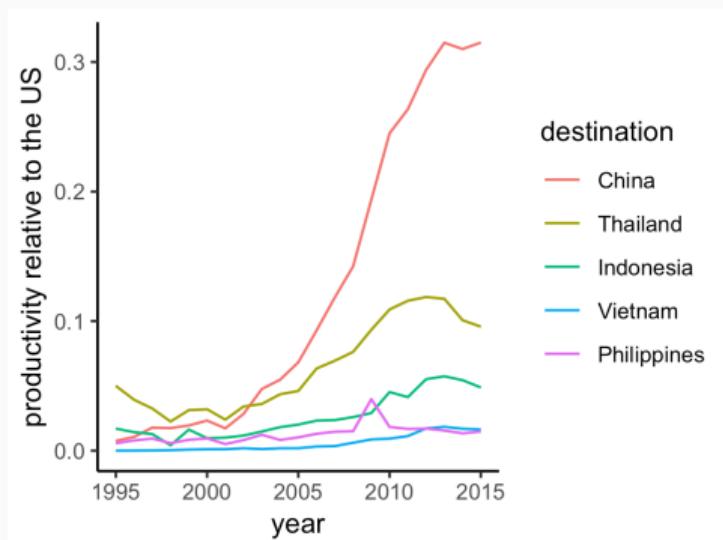
- The relative productivity needs to sort out component a_t^L
- We use JIP database's "Quality of Labor" measure.
 - This reflects changes in the composition of the type of workers—gender, age, education, employment status.
 - We interpret this affects the efficiency units of labor, thereby labor-augmenting productivity.
- We find that the growth $d \ln a_t^L$ is much smaller than $d \ln a_t^M$



Productivity Growth in Each Destination Country

[go back](#)

- We can apply the model inversion for each destination country.
- Productivity growth relative to the base country, US, shows the growth of developing economies.



What is strange if $\lambda < 1$? [go back](#)

- Relative employment L_t^F/L_t^H and wages w_t^F/w_t^H increased.
- Then $\lambda < 1$ would imply that our model inversion

$$\frac{a^M}{a^L} = \left(\frac{M}{L}\right)^{\frac{1}{\lambda-1}} \left(\frac{p^M}{w}\right)^{\frac{\lambda}{\lambda-1}}$$

mean *decreasing* relative foreign productivity.

- We view this as a confirming evidence that $\lambda > 1$.

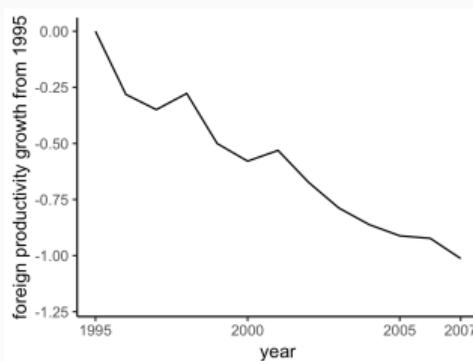


Figure 1: $\lambda = \sigma = 0.2$