Task Offshoring and Organizational Form

Theory and Evidence from China

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Definition

- Offshoring: firms move some of their tasks to a foreign country. E.g. Intel moves the production of chips to China.
  - Intrafirm offshoring (or within-multinational offshoring): firms setup their own subsidiaries in a foreign country to offshore their tasks. E.g. Intel sets up a factory in Dalian, China.
  - Armslength offshoring (or offshoring through subcontracting): firms subcontract their tasks to foreign firms. E.g. Dell subcontracts the production of laptops to a Chinese firm.

Overview

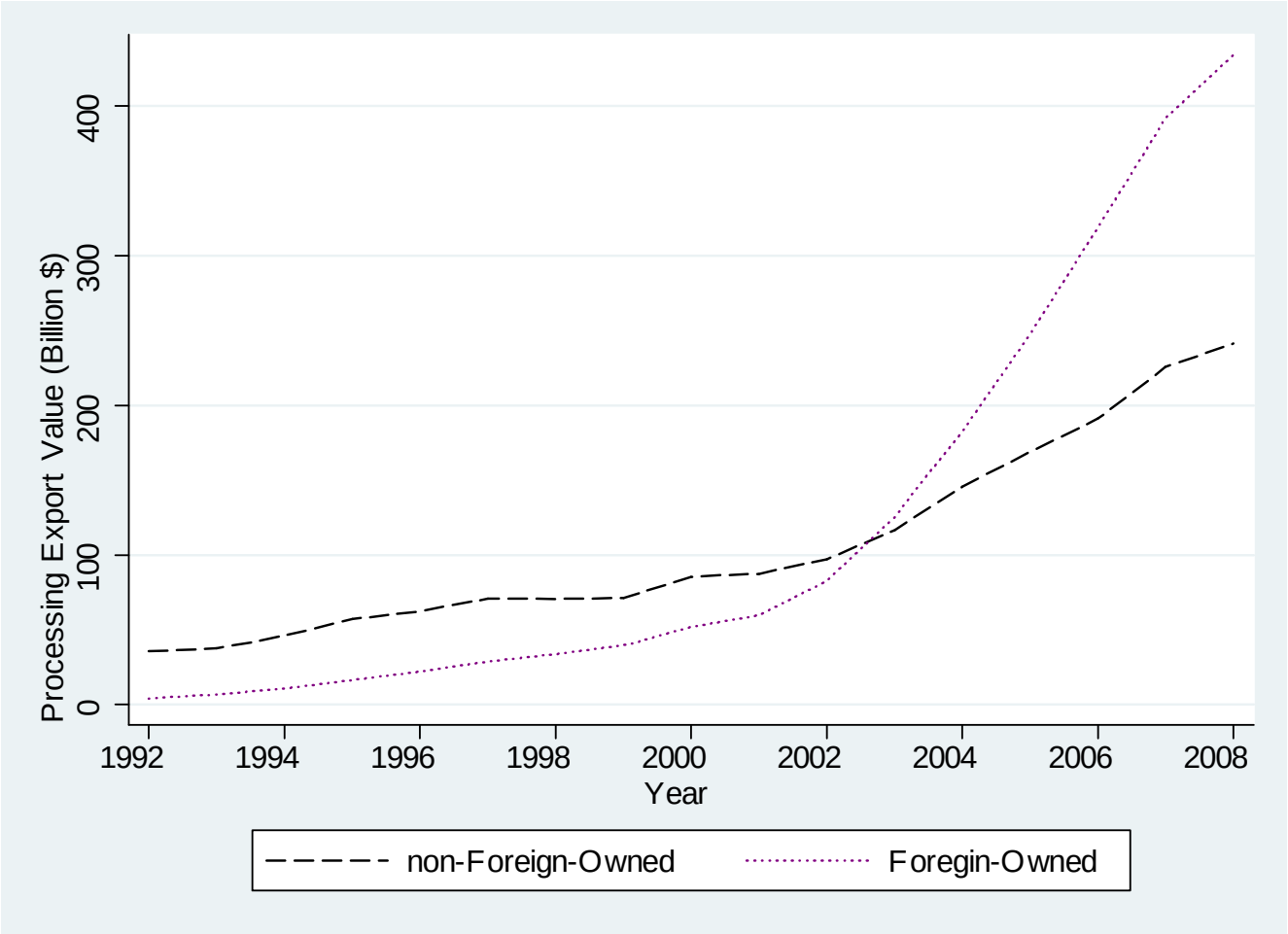
- Intrafirm offshoring grew more rapidly than armslength offshoring in China between 1992-2008 (34% vs. 15%).
- In order to explain this stylized fact, I develop a model incorporating organizational forms into a *task-trading* framework which is developed in Grossman and Rossi-Hansberg (2008).
- The model shows that faster growth of intrafirm offshoring can be explained by reductions in offshoring costs.
- I then present empirical evidence for this theoretical prediction.

Why is this important?

- Offshoring has become a dominant feature of the international economy.
- The "make-or-buy" decision is fundamental to industrial organization. However, the organizational form choice in an offshoring context is not well understood.
- In addition, this paper shows that the offshoring organizational form choice has important welfare implication.

Motivation

Figure: Export Value in Processing Trade by Foreign-Owned firms (intrafirm offshoring) and Non-Foreign-Owned Firms (armslength offshoring)



Literature

Existing studies of organizational form are typically based on contract theory:

- In some studies (Grossman and Helpman (2002), Antràs (2003)), NO industry can have both organizational forms. Thus the models are silent about the prevalence of different organizational forms *within* an industry.
- Antràs and Helpman (2004) study factors that affect the relative prevalence of different organizational forms *within* an industry, but predict that *intrafirm* offshoring becomes *less* prevalent when offshoring cost drops, which is the *opposite* to the observed pattern in China.

My Approach

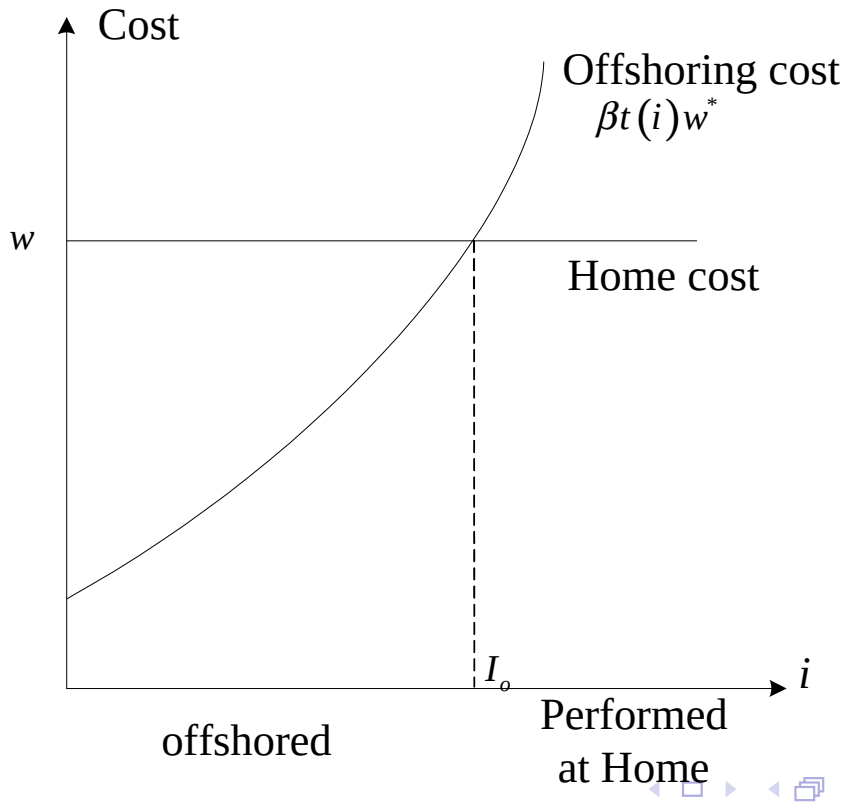
- Incorporating organizational forms into a *task-trading* framework, developed in Grossman and Rossi-Hansberg (2008).
- There is a continuum of tasks, varying in offshoring costs.
  - Tasks could be: basic research, product design, management, components production, assembly, packing, marketing, etc..
  - Tasks could aslo be: for example for a laptop, production of mouse, keyboard, fan, screen, RAM, mother board, CPU or other components.
- *A representative firm* chooses different organizational forms for different tasks.
- The relative prevalence of different organizational forms is determined by the ranges of tasks offshored in each organizational forms.

Theory

Task-trading framework in Grossman and Rossi-Hansberg (2008):

- How complicated the task is to be offshored is indexed by i, $i \in [0, 1]$.
- $t(i)$: task specific offshoring cost for task i.
- β indicates offshoring cost that is common to all tasks.

Grossman & Rossi-Hansberg (2008)



Trade-offs of organizational forms

My approach: trade-offs of different organizational forms

- Intrafirm offshoring communication efficiency is greater than that of armslength offshoring: $K_m > K_a$.
  - K : Number of words used to talk to the manager (Cremer, Garicano, and Prat 2007).
  - $t\left(\frac{i}{K_m}\right) < t\left(\frac{i}{K_a}\right), \forall\ i \neq 0$ and $t(0) = 1$.
  - Moreover, we assume that $\varepsilon(z) \equiv \frac{t'(z)z}{t(z)}$ is an increasing function.

Trade-offs of organizational forms

My approach: trade-offs of different organizational forms

- Intrafirm offshoring pays higher wage than armslength offshoring: $w_m > w^*$(Aitken, Harrison, and Lipsey 1996).
  - Standard shirking model: international monitoring is imperfect (Grossman and Helpman 2004) or local managers of MNCs put less efforts in monitoring than foreign indigenous firms' owners.
  - Other possible reasons that intrafirm offshoring pays higher wage are: higher search cost to hire workers, Intellectual property consideration, investment in training, less bargaining power with labor union, etc..

Trade-offs of organizational forms

- Endogenous gap between w_m and w^*:

$$w_m = w^* + \frac{\rho + q + b\left(\frac{L^*}{L^* - L_m}\right)}{q} d$$

  - foreign labor supply L^*, intrafirm offshoring employment L_m.

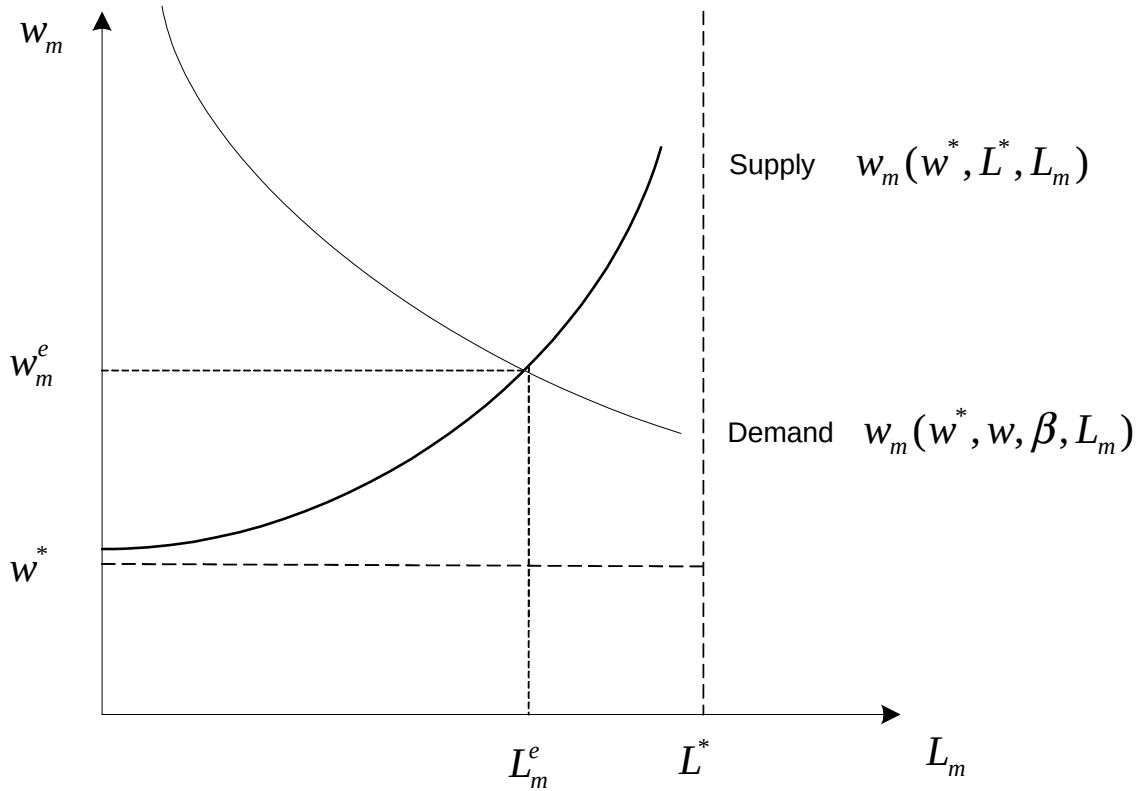
- Intrafirm offshoring labor demand:

$$L_m = \frac{L}{1 - l_o} \beta \int_{l_m}^{l_o} t\left(\frac{i}{K_m}\right) di$$

  - The Intrafirm offshoring labor demand is a function of offshoring cost β. When β drops, the efficiency wage paid by intrafirm offshoring, w_m, drops.
  - There is also feedback effect working through the range of tasks offshored in different organizational forms.

Trade-offs of organizational forms

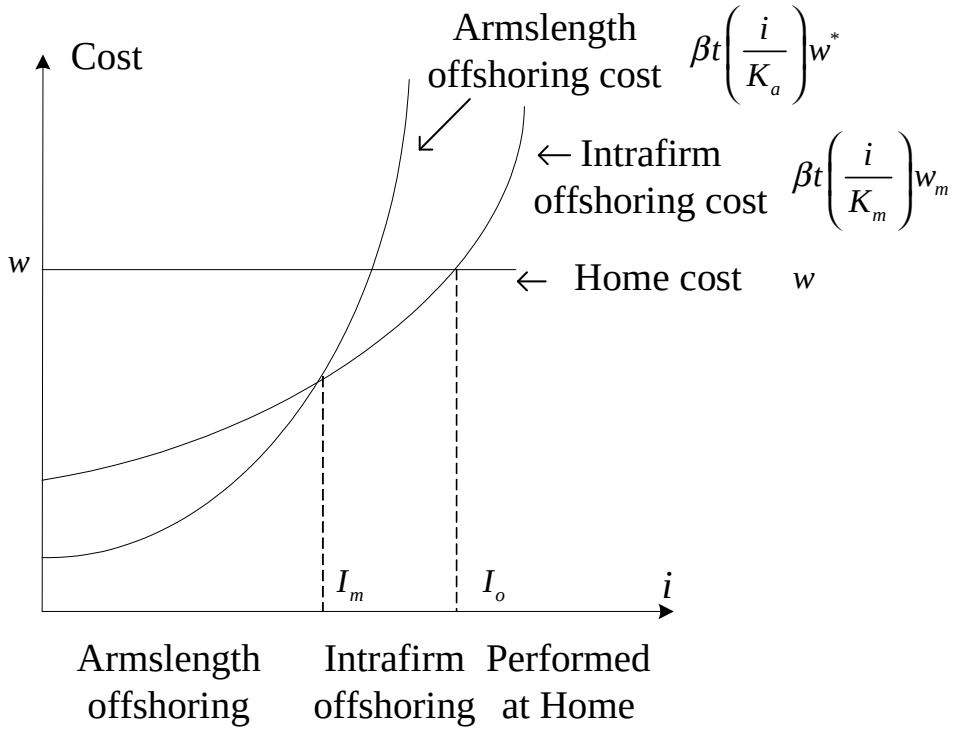
Equilibrium of labor market for intrafirm offshoring:



Trade-offs of organizational forms

Given that $w_m > w^*$ and $t\left(\frac{i}{K_m}\right) \leq t\left(\frac{i}{K_a}\right)$, we have:

My Model: Organizational Form Trade-off

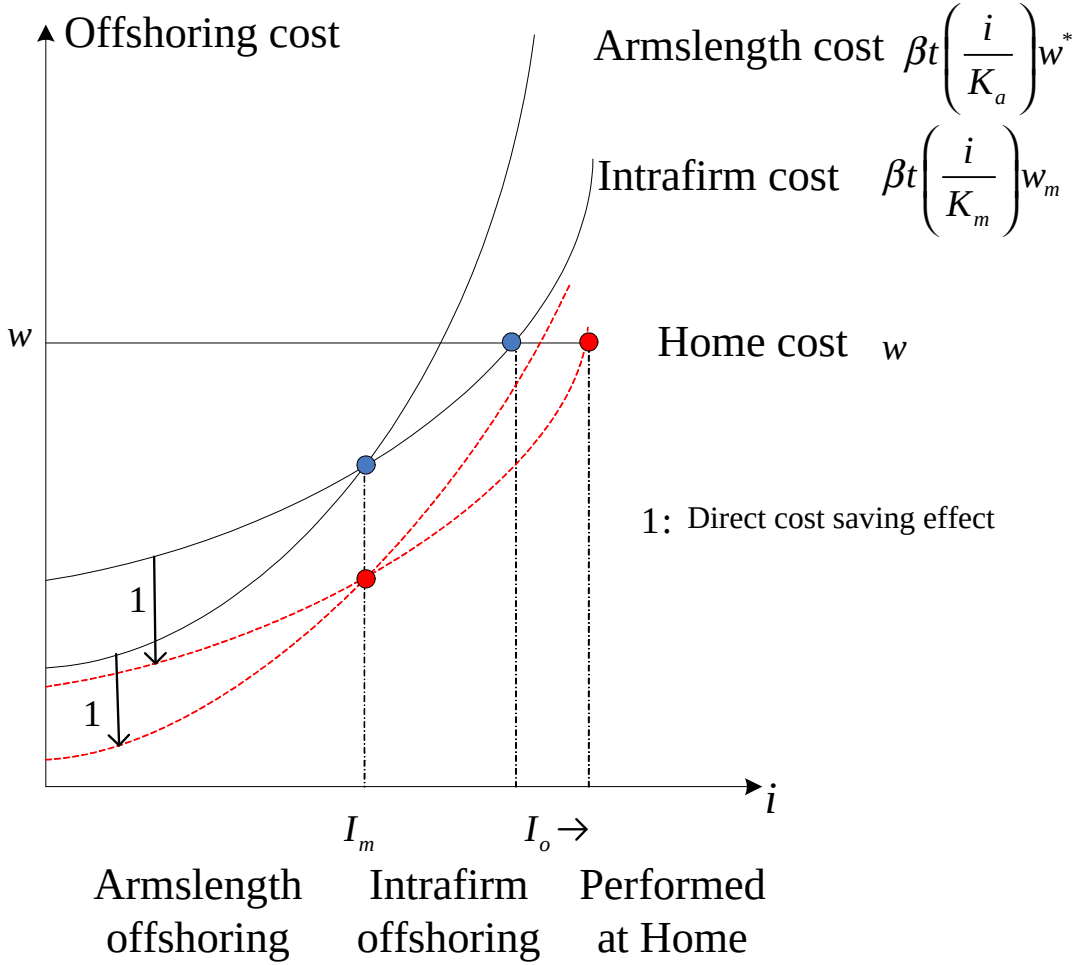


- Tasks offshored in the form of armslength offshoring: $[0, I_m]$. Tasks offshored in the form of intrafirm offshoring: $[I_m, I_o]$.

Theory

The effects of reductions in offshoring costs: β drops

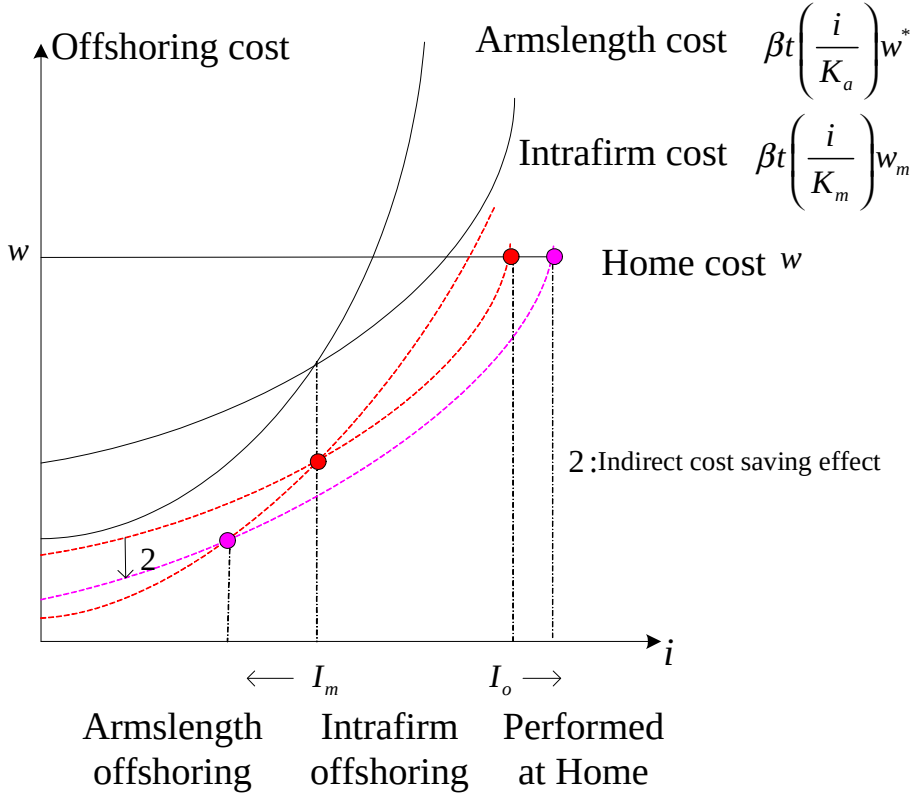
- Direct cost saving effect: keep wage fixed and only β drops.



Theory

The effects of reductions in offshoring costs: β drops

- Indirect cost saving effect: efficiency wage, w_m,drops and w^* fixed.
- Feedback effects push back the efficiency wage and may offset the indirect cost saving effect.



Theory

The welfare implication of organizational form choice for home workers:

- Perfect competition:

$$1 = w\Omega\left(l_o, l_m\right) a_{Lx} + s a_{Hx}$$
$$p = w\Omega\left(l_o, l_m\right) a_{Ly} + s a_{Hy}$$

  where $\Omega\left(l_o, l_m\right) a_{Ly}$ is the effective unit labor requirement for low-skilled workers.

- Reductions in efficiency wage, w_m, drive down Ω and consequently drive up home wage, w.
  - Equivalent to a productivity improvement for home low-skilled workers.

Theory

The effects of reductions in offshoring costs: β drops

- The communication efficiency difference, K_m / K_a, is greater for some industries. The more communication intensive the industry is, the larger this ratio is.
- *Prediction: a fall of offshoring cost is more likely to lead to an increase of intrafirm offshoring share if the industry is more communication intensive*.
- The intuition is
  - When offshoring cost drops, more tasks are offshored in the form of intrafirm offshoring.
  - For industries in which the communication efficiency difference is larger, it is harder to shift tasks from intrafirm offshoring to armslength offshoring.
  - Thus the intrafirm offshoring share is more likely to increase in industries that are more communication intensive.

Theory

Lessons from the theory:

- Reductions of offshoring cost, β, can explain the faster growth of intrafirm offshoring.
- Organizational form choice has important welfare implication for home country workers.
- Testable prediction: *a fall of offshoring cost is more likely to lead to an increase of intrafirm offshoring share if the industry is more communication intensive*.

Data and empirical evidence

- Hypothesis: *a fall of offshoring cost is more likely to lead to an increase of intrafirm offshoring share if the industry is more communication intensive*.
- Data:
  - The Chinese International Trade Dataset over the period 1997-2007
  - The O*NET data and Occupational Employment Statistics of US (OES) in 2002
- Supplement data: China City Statistics (1997-2007)

Data and empirical evidence

Measures:

- Intrafirm offshoring share: Foreign-owned firms' share of processing export (*Intrashare*).
- Offshoring cost reduction: Export Processing Zone dummy, *EPZ*, equals to one if a city has an export processing zone.

Data and empirical evidence

Why EPZs lead to lower offshoring cost

- Exemptions on import and export quota and licensing administration,
- Exemptions on *Bank Deposit Account* management and *Registration Manual* management,
- Exemptions on value-added tax,
- Duty exemptions on all inputs and exports,
- Priority Customs clearance, more streamlined clearance and 24-hour Customs support.
- Modern developed infrastructure, rich human resources and efficient management and services,
- Industrial clusters triggered by special policy zones.

Data and empirical evidence

Measures:

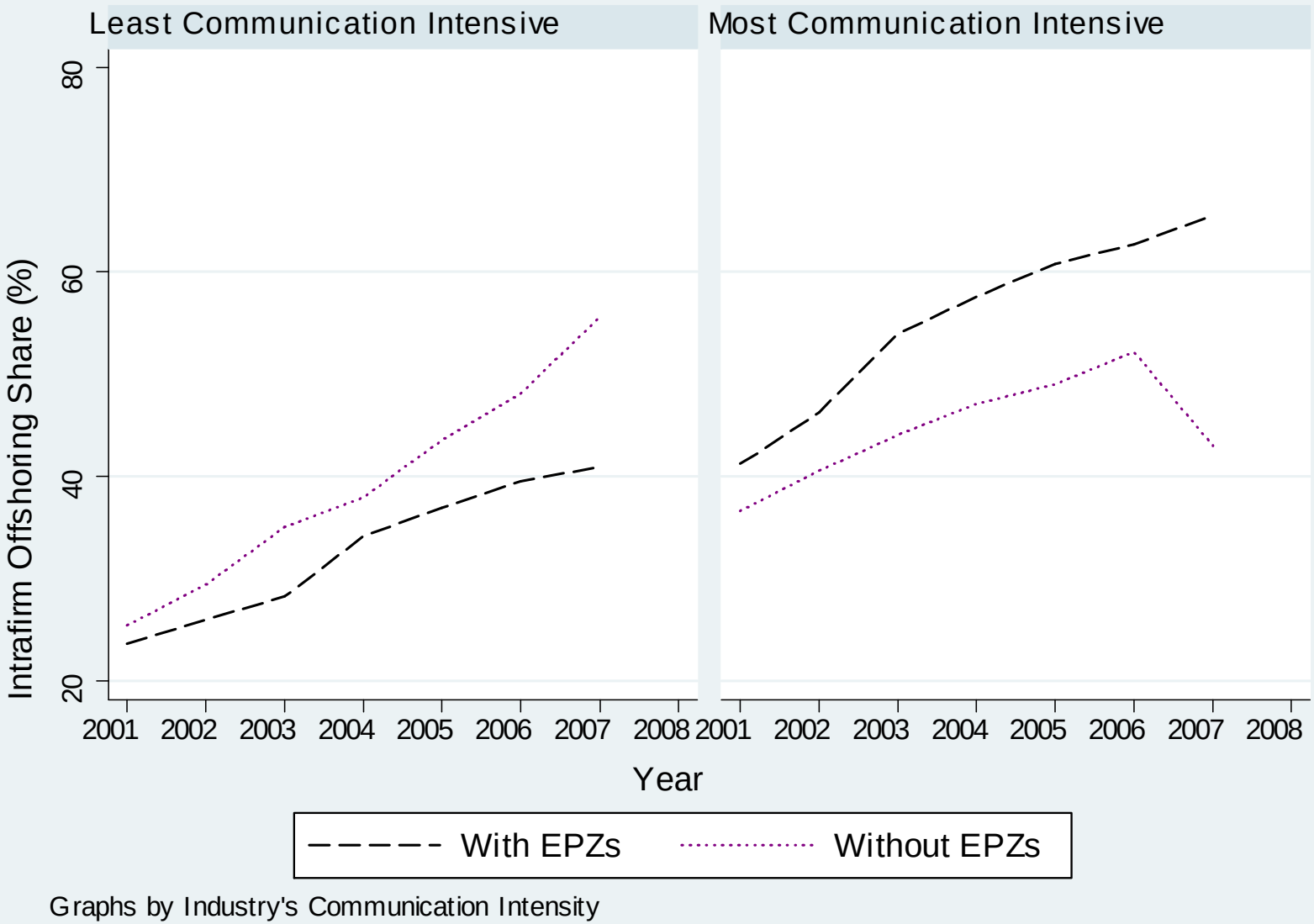
- Communication-intensity: weighted average across occupations of O*NET ratings realated to communication.

$$cintense_j = \sum_i rating_i \cdot \frac{emp_{ij}}{emp_j}$$

  - Most communication-intensive industries: Motor Vehicle; Computer; Navigational, Measuring and Electromedical Equipments.
  - Least communication-intensive industries: Bakeries and Tortilla; Sugar; Animal Slaughtering and Processing

- O*NET ratings for: making decisions and solving problems, cooperation, interpreting information to others, communication with supervisor, peers or subordinates, communication with people outside of the organization, training and teaching others, providing consultation and advice to others, face-to-face discussions, telephone conversation, electronic mail, contact with others.

Data and empirical evidence



Data and empirical evidence

- Basic empirical model:

$$Intrashare_{jct} = \alpha_{jc} + \alpha_t + \beta_1 EPZ_{ct} + \beta_2 EPZ_{ct} \cdot cintense_j + \beta_3 HT_{ct} + \beta_4 NAP_{ct} + \beta_5 NSS_{ct} + \beta_6 Trans_{ct} + \varepsilon_{jct}$$

- Industry-City trend model (random trend model):

$$Intrashare_{jct} = \alpha_{jc} + \alpha_t + g_{jc} t + \beta_1 EPZ_{ct} + \beta_2 EPZ_{ct} \cdot cintense_j + \beta_3 HT_{ct} + \beta_4 NAP_{ct} + \beta_5 NSS_{ct} + \beta_6 Trans_{ct} + \varepsilon_{jct}$$

  - Industry-city specific trend, g_{jc}, is allowed to be correlated with *EPZ* dummy.

Main results

Dependent variable: *intrashare*

Model	Basic Model		Random Trend	
Estimation Method	Within	FD	Within	FD
	(1)	(2)	(3)	(4)
EPZ Dummy (*EPZ*)	-6.019***	-1.604	-1.050	-0.935
	(1.681)	(1.182)	(1.105)	(1.163)
EPZ ∗ *cintense*	11.28*	10.97**	9.009**	9.011**
	(6.176)	(4.555)	(4.215)	(4.148)
HT Dummy (*HT*)	2.541*	2.523*	2.560*	2.451
	(1.526)	(1.388)	(1.310)	(2.016)
Nonagriculture population (*NAP*)	2.080**	4.672***	3.761***	4.350***
	(0.948)	(0.741)	(0.749)	(0.748)
Secondary school student (*NSS*)	13.78*	12.71	7.680	2.642
	(8.281)	(8.288)	(6.733)	(5.370)
Transportaion Infrastructure (*Trans*)	0.0417*	0.106***	0.0827***	0.102***
	(0.0215)	(0.0178)	(0.0179)	(0.0185)
Constant	14.55***		0.509	
	(3.803)		(0.327)	
Prod-City fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Prod-City trend	No	No	Yes	Yes
Observations	385923	291333	291333	228003
Product-City Pairs	92108		63323	
Within R-square	0.083	0.014	0.003	0.002

Robustness check

Preferential policy explanation

Preferential policies attract foreign firms?

- Impacts of Export Processing Zones on different types of foreign-invested firms.
- Impacts of Export Processing Zones established in cities where the preferential policies already exist.

Robustness check

Preferential policy explanation

Dependent Variable	*Intrashare* FIE		*Intrashare* HT	
Model	Random Trend		Random Trend	
Estimation Method	Within	FD	Within	FD
	(1)	(2)	(3)	(4)
EPZ Dummy (*EPZ*)	-1.419	-2.280	-0.886	-0.738
	(1.542)	(1.800)	(1.107)	(1.183)
EPZ $*$ *cintense*	10.35**	12.27**	8.790**	8.522*
	(4.912)	(5.185)	(4.379)	(4.286)
HT Dummy (*HT*)	4.687***	4.795***		
	(0.508)	(0.523)		
Nonagriculture population (*NAP*)	3.274***	3.633***	4.702***	5.276***
	(0.808)	(0.772)	(1.476)	(1.301)
Secondary school student (*NSS*)	3.392	0.0280	4.790	0.640
	(4.570)	(4.377)	(5.479)	(4.248)
Transportaion Infrastructure (*Trans*)	0.0714***	0.0821***	0.0460	0.0812
	(0.0196)	(0.0192)	(0.0655)	(0.0595)
Constant	1.955***		1.609***	
	(0.301)		(0.370)	
Prod-City fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Prod-City trend	Yes	Yes	Yes	Yes
Observations	217030	167374	201039	160395
Product-City Pairs	47400		41389	
R-squared	0.002	0.002	0.003	0.002

Robustness check

Control group issue:

- Pooling all observations of all provinces introduces risks of comparing non-comparable locations.
- Formally, there might be a province-year fixed effect that is correlated with regressors.
- The random trend model partially control this.
- About 92% of all observations of the sample are coming from the east region of China.
- The sample is restricted to only east region provinces.

Robustness check

Dependent variable: *intrashare*

Model	Basic Model		Random Trend	
Estimation Method	Within	FD	Within	FD
	(1)	(2)	(3)	(4)
EPZ Dummy (*EPZ*)	-6.201***	-1.442	-0.917	-0.846
	(1.684)	(1.218)	(1.140)	(1.197)
EPZ ∗ *cintense*	10.41	10.47**	8.763**	8.890**
	(6.339)	(4.699)	(4.317)	(4.250)
HT Dummy (*HT*)	2.824	3.911***	3.925***	4.260***
	(1.746)	(0.721)	(0.501)	(1.338)
Nonagriculture population (*NAP*)	1.601	4.577***	3.707***	4.333***
	(0.972)	(0.755)	(0.752)	(0.762)
Secondary school student (*NSS*)	15.32*	13.33	7.630	2.443
	(8.791)	(8.934)	(7.052)	(5.553)
Transportaion Infrastructure (*Trans*)	0.0311	0.103***	0.0811***	0.102***
	(0.0215)	(0.0182)	(0.0180)	(0.0189)
Constant	16.30***		0.577*	
	(4.129)		(0.344)	
Prod-City fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Prod-City trend	No	No	Yes	Yes
Observations	355208	271668	271668	214630
R-squared	0.086	0.015	0.003	0.002
Product-City Pairs	81058		57031	

Robustness check

Other Robustness Checks

- Regard JVs as intrafirm offshoring
- Using export quantity rather than export value to measure intrafirm offshoring share
- Control intellectural property of industries
- Control capital intensity of the industries
- Cross region comparation

Conclusion

- This paper explains the relative faster growth of intrafirm offshoring observed in China.
- Moreover, the paper explains the industry difference in the responce of the relative prevalence of intrafirm offshoring to reductions of offshoring costs.
- It develops a simple model that incorporates different organizational forms into a task-trading framework.
- Empirical findings: reductions of offshoring cost that are due to establishment of Export Processing Zones lead to a change of intrafirm offshoring share:
  - close to 0 in least communication-intensive industries.
  - 8 percentage point *increase* in most communication-intensive industries.

Aitken, B., A. Harrison, and R. E. Lipsey (1996): "Wages and foreign ownership A comparative study of Mexico, Venezuela, and the United States," *Journal of International Economics*, 40(3-4), 345 – 371.

Antràs, P. (2003): "Firms, Contracts, and Trade Structure," *Quarterly Journal of Economics*, 118(4), 1375–1418.

Antràs, P., and E. Helpman (2004): "Global Sourcing," *Journal of Political Economy*, 112(3), 552–580.

Gremer, J., L. Garicano, and A. Prat (2007): "Language and the Theory of the firm," *The Quarterly Journal of Economics*, 122(1), 373–407.

Grossman, G., and E. Helpman (2002): "Integration versus Outsourcing in Industry Equilibrium," *Quarterly Journal of Economics*, 117(1), 85–120.

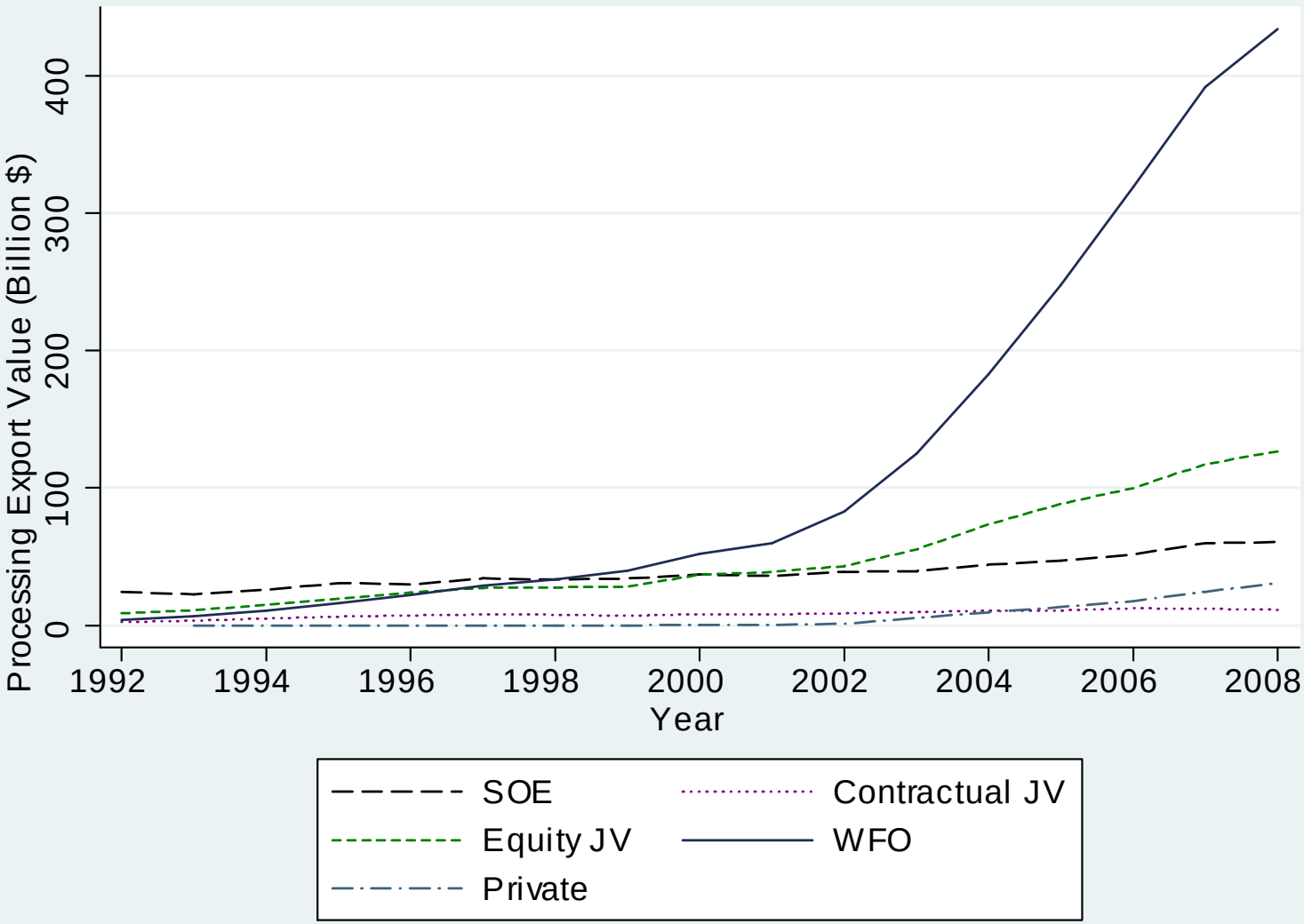
Grossman, G., and E. Helpman (2004): "Managerial incentives and the international organization of production," *Journal of International Economics*, 63(2), 237–262.

Grossman, G., and E. Rossi-Hansberg (2008): "Trading tasks: a simple theory of offshoring," *American Economic Review*, 98(5).

Appendix

Stylized fact

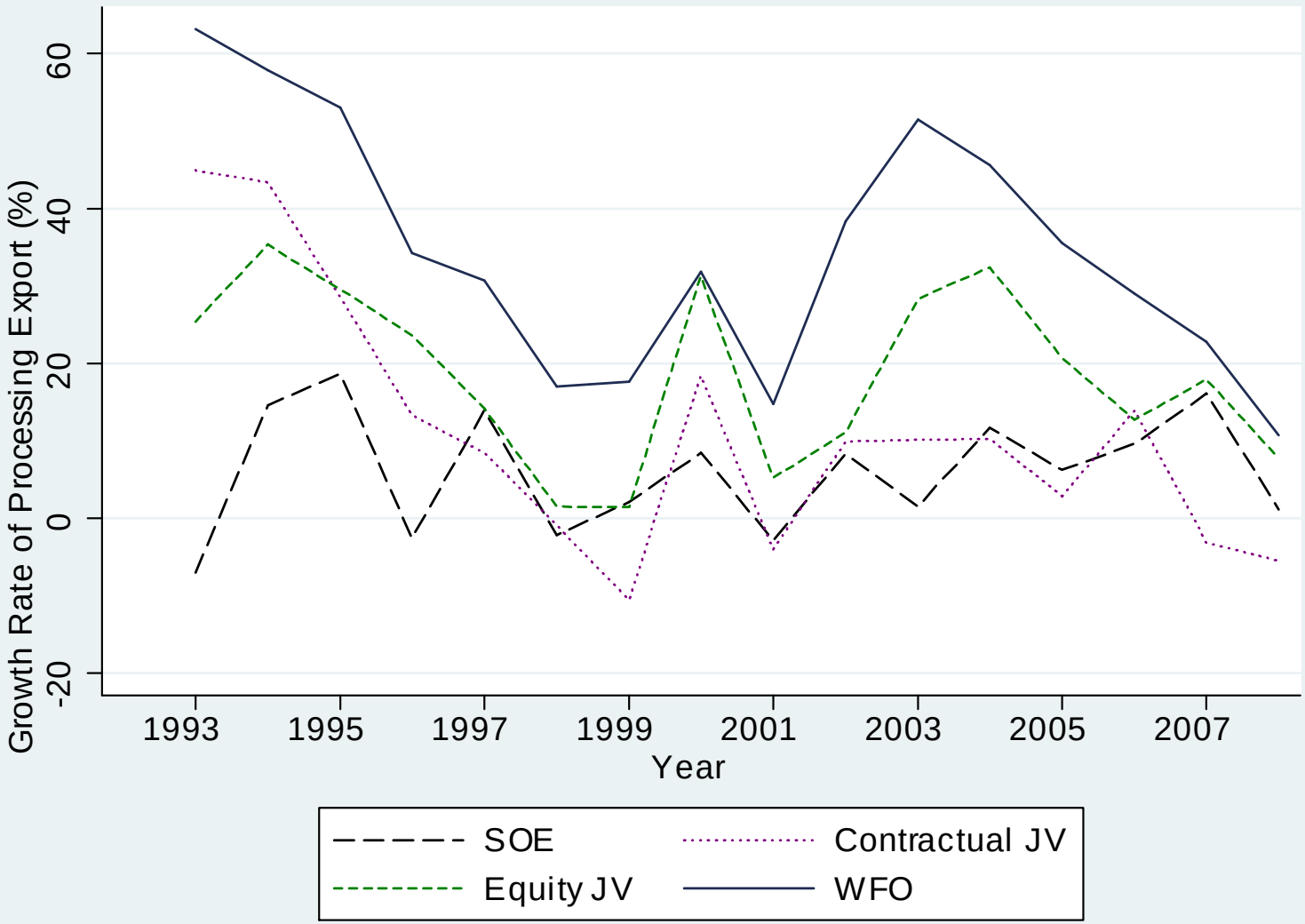
More disaggregate firm types



Appendix

Stylized fact

Growth rates of processing export



Brief history of Foreign-Owned Firms Policy:

- Starting from July 8th, 1979, laws are established for Equity Joint Ventures.
- Starting from April 13th, 1988, laws are established for Contractual Joint Ventures.
- Starting from April 12th, 1986, laws are established for Wholly-Foreign-Owned firms.
- According to the *Catalogue of Industries for Guiding Foreign Investment (1997),* most of the manufacturing industries are allowed for foreign-invested firms.
- In the dataset for 1988 to 2008, WFO firms shows up as early as 1988.

Appendix

Efficiency wage

- International monitoring is imperfect.
- Workers in MNCs might shirk (MNC refers to intrafirm offshoring firms).
- The asset value for non-shirking MNC employee, shirking MNC employee and non-MNC employee are

$$\begin{aligned}\rho V_{mn} &= w_m - d + b\left(V_a - V_{mn}\right),\\ \rho V_{ms} &= w_m + \left(b+q\right)\left(V_a - V_{ms}\right),\\ \rho V_a &= w^* + e\left(V_{mn} - V_a\right),\end{aligned}$$

- In steady state: $e\left(L^* - L_m\right) = bL_m$

$$w_m\left(w^*, L^*, L_m\right) = w^* + \frac{\rho + q + b\left(\frac{L^*}{L^* - L_m}\right)}{q} d. \tag{1}$$

Appendix

Zero-profit condition

- Zero-profit condition of both goods, for $j = X, Y$:

$$p_j = wa_{Lj}\left(1 - l_o\right) + w^* a_{Lj} \int_0^{l_m} \beta t\left(\frac{i}{K_a}\right) di$$
$$+ w_m a_{Lj} \int_{l_m}^{l_o} \beta t\left(\frac{i}{K_m}\right) di + sa_{Hj}$$

- Rewrite them and take good X as numeraire:

$$1 = \Omega\left(l_o, l_m\right) wa_{Lx} + sa_{Hx}$$
$$p = \Omega\left(l_o, l_m\right) wa_{Ly} + sa_{Hy}$$

where

$$\Omega\left(l_o, l_m\right) \equiv \left(1 - l_o\right) + \frac{1}{t\left(\frac{l_o}{K_m}\right)} \frac{t\left(\frac{l_m}{K_m}\right)}{t\left(\frac{l_m}{K_a}\right)} \int_0^{l_m} t\left(\frac{i}{K_a}\right) di + \frac{\int_{l_m}^{l_o} t\left(\frac{i}{K_m}\right) di}{t\left(\frac{l_o}{K_m}\right)}.$$

Basic Statistics for Key Variables

Variables	Obs.	Mean	Std.Dev.	Min	Max
WFO share of processing export*100 (*Intrashare*)	431281	37.465	44.602	0	100
WFO share of processing export by FIEs*100 (*IntrashareFIE*)	328265	57.359	46.072	0	100
WFO share of processing export outside special policy zones*100 (*Intrashareoutzone*)	384758	34.702	43.833	0	100
EPZ Dummy	431281	0.275	0.447	0	1
Communication intensity (*cintense*)	394481	0.274	0.092	0	1
HT Dummy	431281	0.672	0.469	0	1
Non-agriculture population in million persons (*NAP*)	427741	2.592	2.561	0.120	11.969
Number of secondary school students in million persons (*NSS*)	425427	0.323	0.206	0.000	2.305
Proxy of transportation Infrastructure (Passenger number/population, *Trans*)	429889	34.527	41.898	1.890	285.830

Predicted change of *Intrashare*

Year	Weighted Average of *cintense*	Weighted Average of *Intrashare* (%)	Predicted Percentage Increase of *Intrashare* (%)
1997	0.274102	27.568	5.14867
1998	0.28794	30.3509	5.087327
1999	0.291045	32.6892	4.809016
2000	0.295017	34.9111	4.605438
2001	0.301966	38.6449	4.322479
2002	0.323218	44.2246	4.210047
2003	0.356737	49.9343	4.333387
2004	0.353906	53.9742	3.961785
2005	0.349165	58.447	3.585517
2006	0.34351	61.4782	3.325861
2007	0.441582	62.2684	4.702559
2008	0.495614	60.0692	5.685098