Foreign Direct Investment and Industrial Agglomeration: Evidence from China

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Two Mechanisms for Economic Growth

- Agglomeration of economic activities (Jacobs 1969, Lucas 1988, Krugman 1991)
  - Industrialization and urbanization
- Technology diffusion (Howitt 2000, Acemoglu,Zilibotti & Aghion 2006)
  - Convergence hypothesis – Taking off requires quick learning/imitation in technology.
- The rationales of special economic zones include to cluster firms/industries and to facilitate technology diffusion.

Two Mechanisms for Economic Growth

- The success story of Shenzhen!
  - Close to Hong Kong, and hence a new gate of China.
  - Previously fishing villages, and now a metropolitan of over 10 millions and a major manufacturing hub.
- The two mechanisms are *not orthogonal*.
  - Firms cluster.
  - Foreign direct investments (FDI) tend to cluster.
  - Locations with numerous foreign firms are especially attractive for domestic firms due to technology diffusion.
- Does FDI leads to industrial agglomeration?

FDI Deregulation in April 2002

We explore a particular historical event to empirically examine the effect of FDI on industrial agglomeration

- FDI deregulation upon the WTO accession in China.
- Variations in deregulation across industries –> DD identification.
- We find a *negative* effect of FDI deregulation on industrial agglomeration.

Theory of FDI and Industrial Agglomeration

- We propose a theory of FDI and industrial agglomeration based on the following two counter-veiling forces.
  - Technology diffusion fosters agglomeration.
  - Competition among firms discourages agglomeration.

Theory of FDI and Industrial Agglomeration

- The theory predicts a hump shape in the relation of industrial agglomeration with foreign capital.
  - (+) When the economy or the size of total foreign capital is small, the technology diffusion attracts domestic firms to where the foreign capital is located. At this stage, competition pressure is small.
  - (–) When the economy or the size of total foreign capital is large, competition pressure is large. Meanwhile, the productivity gaps may have become small.
- Our mechanism test shows that the markups, profits, and sales all decrease by FDI deregulation.

FDI, Industrial Agglomeration and Growth

- One main reason that economists care about FDI and agglomeration is about growth – do FDI and industrial agglomeration promote growth?
- Empirically, we find that
  - FDI deregulation does increase industrial growth rate.
  - Agglomeration also increase growth.
  - However, de-agglomeration induced by FDI de-regulation reduce growth rate by about 17%.
- This rationalizes FDI-promoting and agglomeration-promoting policies, of which the combinations are special economic zones.

Literature Review

- Here, we distinguish between "industrial agglomeration" and "agglomeration":
  - Agglomeration (when firms and people cluster together; macro-scope; cities); e.g., Krugman (1991), Helpman (1998), Ottaviano, Tabuchi, and Thisse (2002), Murata (2003), Behrens et al (2014).
  - Industrial agglomeration (given population distribution, examining an industry's geographic concentration or the lack of); e.g., Ellison and Glaeser (1997; empirical). Few theoretical studies.
- A first theory on how FDI affects industrial agglomeration.

Literature Review

On the effects of competition

- In theories of "agglomeration", competition effects may be conducive to agglomeration because consumers enjoy lower prices (e.g., Ottaviano, Tabuchi and Thisse 2002)
- For "industrial agglomeration", competition discourages agglomeration of firms.

Roadmap

- Background
  - FDI regulations in China
  - Data and variables
- Empirical Analysis
  - Identification strategy
  - Main findings
  - Robustness
- A Theory of FDI and Industrial Agglomeration
  - Model and Results
  - Empirical support
- Concluding Remarks – some policy implications

Background – FDI Regulations in China

- Since the open-door policy in 1978, a series of laws on FDI and implementation measures were introduced and revised.
  - In July 1979, a "Law on Sino–Foreign Equity Joint Ventures" was passed to attract foreign direct investment.
  - In September 1983, the "Regulations for the Implementation of the Law on Sino–Foreign Equity Joint Ventures" was issued by the State Council of China; it was revised in January 1986, December 1987, and April 1990.
  - In April 1986, the "Law on Foreign Capital Enterprises" was enacted.
  - In October 1986, "Policies on Encouragement of Foreign Investment" was issued by the State Council of China.

FDI Regulations in China

- Government guidelines for regulating the inflows of FDI
  - In June 1995, the central government of China promulgated "the Catalogue for the Guidance of Foreign Investment Industries"
  - modifications made in 1997
- The Catalogue classified products into four categories
  - (i) FDI was supported, (ii) FDI was permitted, (iii) FDI was restricted, and (iv) FDI was prohibited.
- After the WTO accession in November 2001, central government substantially revised the Catalogue in March 2002, and made minor revisions in November 2004

Data and Variables: A Panel Data of Industries

- *Annual Survey of Industrial Firms* (ASIF)
  - conducted by the National Bureau of Statistics of China for the 1998–2007 period
  - cover all SOEs and all of the non-SOEs with annual sales over 5 million Chinese yuan (about US$827,000)
  - the number of firms covered varies from approximately 162,000 to approximately 270,000
  - more than 100 variables, including the basic information, and the financial and operational information extracted from accounting statements
  - adjusting the changes in the industry classification system in 2001 and the changes in the location codes over time

Data and Variables: Measures of Industrial Agglomeration

- EG index (Dartboard approach)

$$EG_i \equiv \frac{G_i - (1 - \sum_r x_r^2) H_i}{(1 - \sum_r x_r^2)(1 - H_i)},$$

where $G_i \equiv \sum_r (x_r - s_r^i)^2$ with x_r the share of total output of all industries in region r, and s_r^i the share of output of region r in industry i. H_i is the Herfindahl index of industry i.

  - using prefectures (~380 in China) as the unit in the baseline and counties in the robustness

Data and Variables: FDI Deregulation Measures

- Comparing the 1997 and 2002 Catalogues
- Three possible cases of changes
  - FDI encouraged products
  - FDI discouraged products
  - FDI no-change products

Data and Variables: FDI Deregulation Measures

- Matching product level in the Catalogue to industry (CIC4) in the firm-level data
- Four possible outcomes
  - FDI encouraged industries: 112 (out of 424 CIC4 industries)
  - FDI no-change industries: 300
  - FDI discouraged industries: 7
  - FDI mixed industries: 5

FDI Deregulation and FDI Inflows

Table 2: FDI Inflows Before and After WTO Accession

	(1)	(2)	(3)
	1998–2001	2002–2007	Percentage change (%)
Panel A. Foreign equity share for the treatment and control groups			
Treatment	0.244	0.312	27.99
Control	0.217	0.250	15.46
Panel B. Share of number of foreign firms for the treatment and control groups			
Treatment	0.131	0.161	22.78
Control	0.192	0.208	8.48

Note: Foreign equity share in Panel A and share of foreign firms in Panel B, in the treatment and control groups, calculated over the pre-WTO 1998–2001 period, the post-WTO 2002–2007 period, and their percentage changes.

- DD estimation
  - time difference: before and after the deregulation in 2002
  - cross sectional difference: FDI encouraged industries versus FDI no-change industries
- Specification

$$y_{it} = \alpha_i + \beta\, Treatment_i \times Post2002_t + \mathbf{X}_{it}^{'}\boldsymbol{\lambda} + \gamma_t + \varepsilon_{it}$$

- Identifying assumption

$$cov\left(Treatment_i \times Post02_t, \varepsilon_{it} | \mathbf{W}_{it}\right) = 0.$$

Empirical Analysis – Estimation Strategy

- Nonrandom timing of FDI deregulation in 2002
  - γ_t leaves the biases only from the differential changes between the treatment and control groups
  - lengthy WTO accession process:
    - 15 years of negotiations with 150 member countries
    - several remaining issues, such as farm subsidies, were still unresolved in mid-2001.
  - other on-going changes: SOE reforms, tariffs reduction, changes in the SEZs upon the WTO accession

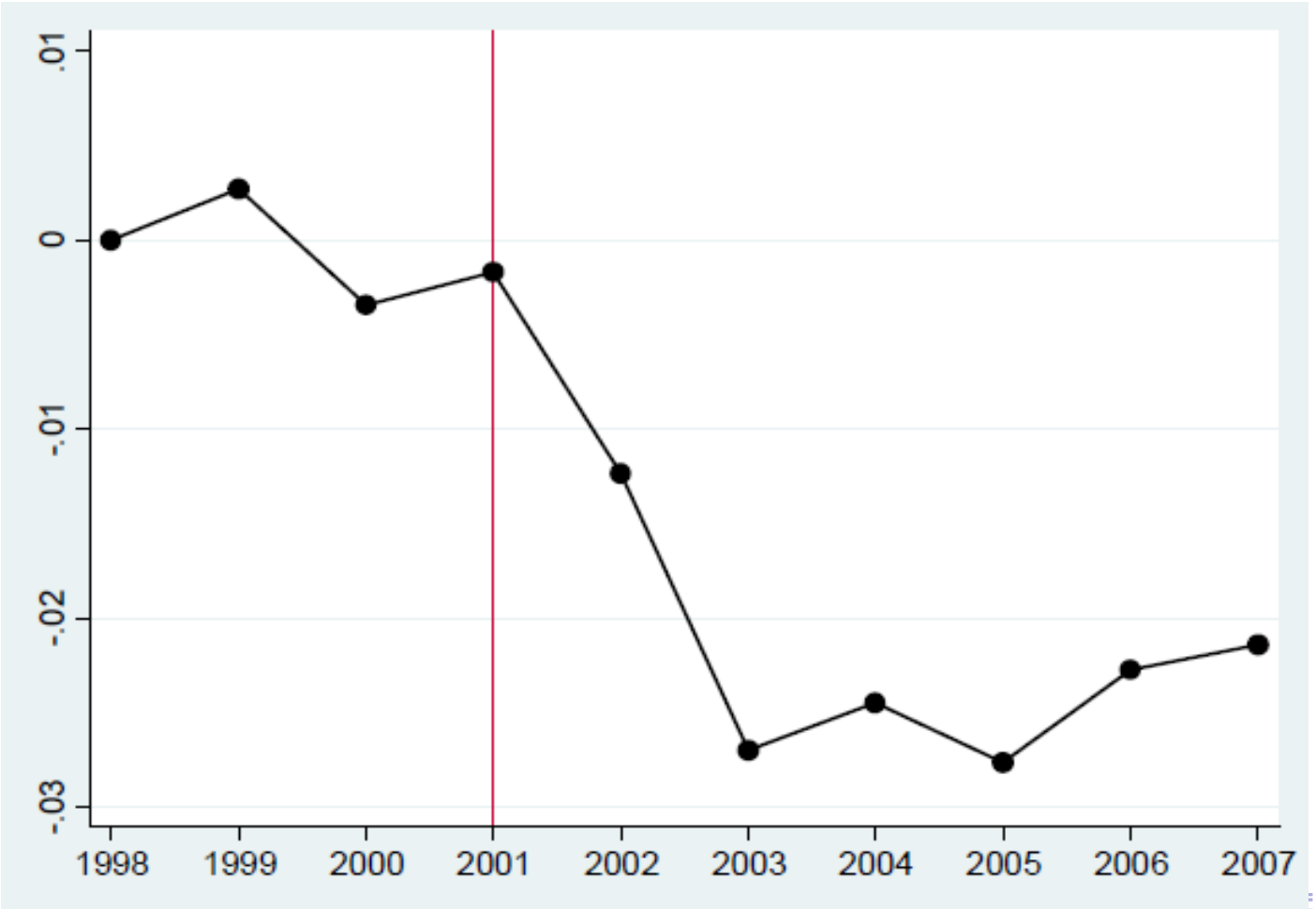
Empirical Analysis – Estimation Strategy

- Checking the expectation effect:
  - We include an additional control in the regression, $Treatment_i \times$ *One Year Before WTO Accession*$_t$; any significant coefficient of this additional control variable would indicate possible expectation effects.
- Controlling for other on-going changes: add interaction terms of $Post02_t$ with
  - industry-level SOE share
  - various tariffs
  - the share of industry output from the special economic zones in 2001
  - the share of industry output in the "West" to control for the potential effect due to the Western Development Program.
  - vertical FDI for upstream and downstream influences

Empirical Analysis – Estimation Strategy

- Nonrandom selection of FDI encouraged industries
  - comparability between the treatment and control groups
- Remedies
  - a strategy following Gentzkow (2006): conditionally plausibly random
  - characterizing important determinants $\mathbf{Z}_{i2001}$ for FDI deregulation changes in 2002
  - Lu, Tao, and Zhu (2017): $\mathbf{Z}_{i2001}$ – new product intensity, export intensity, number of firms, and average age of firms in the industry
  - adding $\mathbf{Z}_{i2001} \times \gamma_t$ to control flexibly for post-WTO differences in the time path of the outcomes that are caused by the endogenous selection of industries for changes in FDI regulations.
  - further controlling for time-varying industrial characteristics

The time trend of the difference in the EG index between the treatment and control groups



Empirical Analysis

Main Results

Table 3: Main Results

	Dependent variable: industrial agglomeration (EG index, prefecture level)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment × Post02	−0.020**	−0.018**	−0.019**	−0.020**	−0.021**	−0.021**	−0.022***	−0.023***
	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Observations	4,076	4,076	4,076	4,076	4,076	4,076	4,076	4,076
Additional controls:								
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Control for determinants of FDI regulation changes	no	yes	yes	yes	yes	yes	yes	yes
Control for tariff reductions	no	no	yes	yes	yes	yes	yes	yes
Control for SOE reforms	no	no	no	yes	yes	yes	yes	yes
Control for special economic zones	no	no	no	no	yes	yes	yes	yes
Control for Western Development Program	no	no	no	no	no	yes	yes	yes
Control for time-varying industry characteristics	no	no	no	no	no	no	yes	yes
Control for vertical FDI	no	no	no	no	no	no	yes	yes

Empirical Analysis – Robustness Checks

- The determinants of FDI regulation changes might be correlated with omitted time-varying industry characteristics:
  - IV: for three of the four identified determinants, use the Colombian counterparts and interacting it with $Post02_t$. (Ellison, Glaeser and Kerr 2011).
  - The Colombian measures are averaged over 1981 to 1991 over the median firm in each industry.
  - The instruments are unlikely to be correlated with the error term because trade and FDI between China and Colombia in the 1980s are quite small.
- Other checks
  - constructing EG by county
  - expectation effect (adding $Treatment_i \times$ *One Year Before WTO Accession*$_t$)
- To check whether the result are driven by omitted variables:
  - Conduct placebo test by constructing false policy reforms ($Treatment_i^{false} \times Post_t^{false}$) as random draws of year of change and of the treatment industries

IV; Expectation Effect; Alternative Measures

Table 4: Robustness Checks

	Dependent variable: industrial agglomeration				
	EG index (prefecture level); Columbia instruments	Discouraged industries included in the control group	EG index (county level)	EG index (prefecture level)	EG index (county level)
	(1)	(2)	(3)	(4)	(5)
Treatment × Post02	−0.143**	−0.022**	−0.014**	−0.023***	−0.014**
	(0.063)	(0.009)	(0.007)	(0.008)	(0.007)
Treatment × One Year Before WTO Accession				−0.001	0.001
				(0.005)	(0.004)
Observations	4,066	4,136	4,076	4,076	4,076
Anderson-Rubin Wald test	8.40**	–	–	–	–
Stock-Wright LM S statistic	91.75***	–	–	–	–
Hansen's J statistic	3.90	–	–	–	–
p-value of Hansen J statistic	0.14	–	–	–	–
Additional controls:					
Industry fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes
Control for determinants of FDI regulation changes	yes	yes	yes	yes	yes
Control for tariff reductions	yes	yes	yes	yes	yes
Control for SOE reforms	yes	yes	yes	yes	yes
Control for special economic zones	yes	yes	yes	yes	yes
Control for western development program	yes	yes	yes	yes	yes
Control for time-varying industry characteristics	yes	yes	yes	yes	yes
Control for vertical FDI	yes	yes	yes	yes	yes

Placebo Test: Randomly Assigned Policy Reform

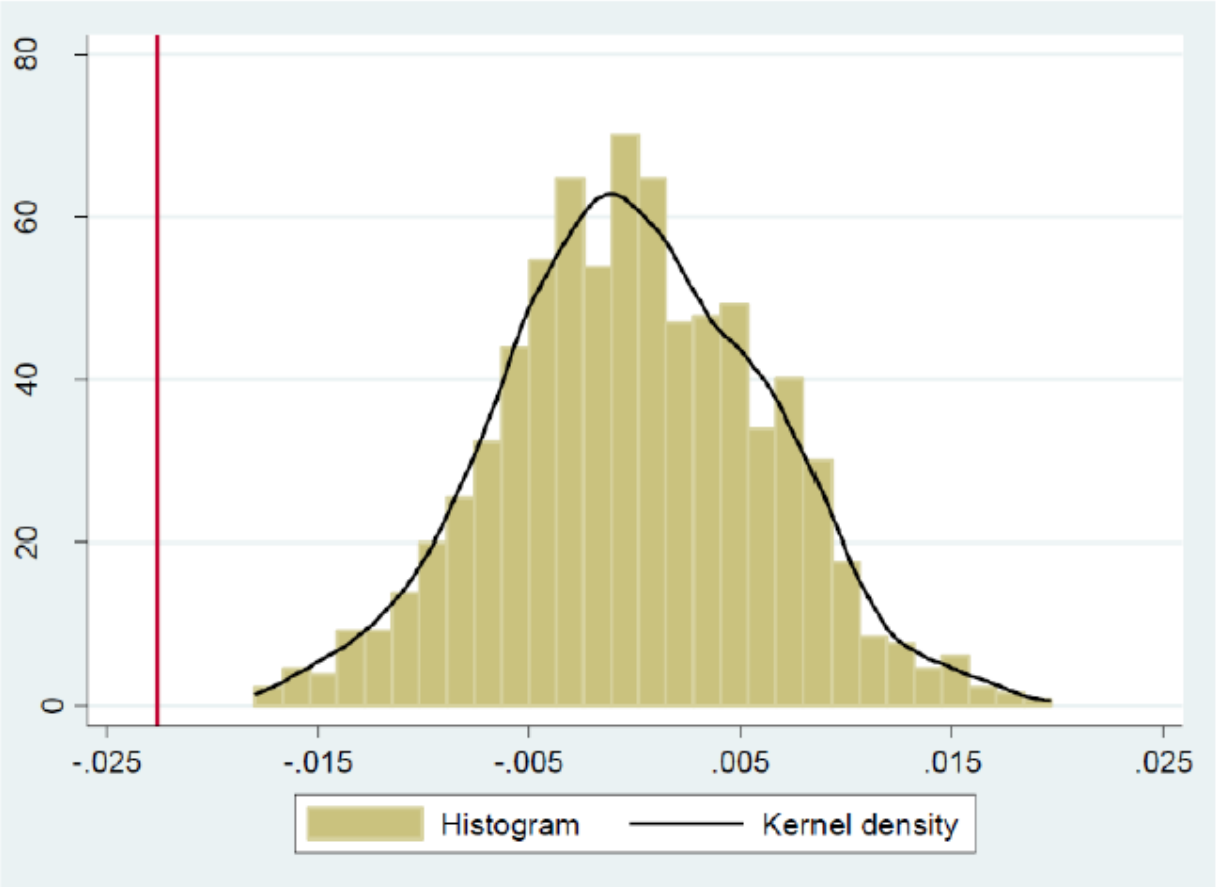


Figure 2: Distribution of estimated coefficients in the placebo test

A Theory of FDI and Industrial Agglomeration

- To model industrial agglomeration, we depart from canonical theories of agglomeration by basing the model via the viewpoint of firms (instead of both firms and workers/consumers)
    - key difference: whereas competition benefits consumers and hence encourages agglomeration, it hurts firms and causes industries to de-agglomerate
- There are two types of firms: foreign (more productive) and domestic (less productive)
- Incorporation of technology diffusion.

A Theory of FDI and Industrial Agglomeration

- Consider a country with two regions, $i = 1, 2$.
- A mass of immobile consumers $\bar{L}_i$ living in each region such that $\bar{L}_1 + \bar{L}_2 = \bar{L}$.
- Suppose for some reason, there are more foreign firms in region 1, then
  - This attracts domestic firms to locate in region 1 for technology diffusion.
  - But region 1 becomes more competitive, and some firms may want to leave.

A Theory of FDI and Industrial Agglomeration

- To highlight the tradeoff between technology diffusion and competitive effects, assume foreign firms can only be located in region 1. (Think of SEZs or broader policy restrictions/incentives)
- Domestic firms are freely mobile.
- If foreign firms are also mobile, one can add an agglomeration force to so that one region will have more foreign firms than the other, then our results still hold in this context.

Demand

- The basic model follows the monopolistic competition model in Melitz and Ottaviano (2008).

- Representative consumer living in region i:

$$\max_{q_0, q_{ji}(\omega)} U_i = q_0 + \alpha \sum_j \int_{\omega \in \Omega_j} q_{ji}(\omega) d\omega - \frac{\gamma}{2} \sum_j \int_{\omega \in \Omega_j} q_{ji}^2(\omega) d\omega$$

$$- \frac{\eta}{2} \left(\sum_j \int_{\omega \in \Omega_j} q_{ji}(\omega) d\omega \right)^2$$

$$s.t.\ q_0 + \sum_j \int_{\omega \in \Omega_j} p_{ji}(\omega) q_{ji}(\omega) d\omega = y_i + \bar{q}_0,$$

- Individual demand function (note the choke price)

$$q_{ji} = \begin{cases} \frac{1}{\gamma} \left(p_i^m - p_{ji} \right) & p_{ji} \leq p_i^m \\ 0 & p_{ji} > p_i^m \end{cases}.$$

Demand

- The choke price is given by

$$p_i^m = \frac{\gamma\alpha + \eta P_i}{\gamma + \eta N_i},$$

where

$$P_i \equiv \sum_j \int_{\omega \in \Omega_{ji}^c} p_{ji}(\omega) d\omega. \tag{1}$$

- choke price: $p_i^m = \frac{\gamma\alpha+\eta P_i}{\gamma+\eta N_i}$; $N_i \uparrow$, $p_i^m \downarrow$
- $\varepsilon_{ji} = -\frac{\partial q_{ji}^c}{\partial p_{ji}} \frac{p_{ji}}{q_{ji}^c} = \left[\frac{p_i^m}{p_{ji}} - 1\right]^{-1}$: $N_i \uparrow$, $\varepsilon_{ji} \uparrow$

Production

- The numeraire goods q_0 are produced using one-to-one constant-returns technology, and freely traded between the two regions. Thus $w_1 = w_2 = 1$.
- For the differentiated sector, ϕ units of capital is required to set up a firm.
- Upon hiring ϕ units of capital to set up, each entrant in region i obtains a distinct product and draws its unit labor requirement c from a given distribution $G_i^s(c)$, $s = H, F$.
- Choke price in a region i determines the selection cutoff c_i such that entrants in i with $c > c_i$ will exit.

Entry and the Distribution of Firms

- The standard iceberg trade cost:
  - For each good ω, τ_{ji} units need to be shipped in order to deliver 1 unit to region i from region j.
  - $\tau_{ji} = \tau > 1$ if $j \neq i$, and $\tau_{ji} = 1$ if $j = i$.
- By choosing units for capital, we can normalize ϕ to 1. So, one unit of capital translates to one entrant.
- The total capital $\bar{K}$ in this country consists of domestic capital K^H and foreign capital (FDI) K^F.

Entry and the Distribution of Firms

- Define the fraction of *active* firms in region 1 as

$$f \equiv \frac{K^F G_1^F\left(c_1^D\right) + K_1^H G_1^H\left(c_1^D\right)}{K^F G_1^F\left(c_1^D\right) + K_1^H G_1^H\left(c_1^D\right) + K_2^H G_2^H\left(c_2^D\right)}.$$

- Actually easier to work with the ratio of *active* firms between the two regions:

$$\lambda \equiv \frac{K^F G_1^F\left(c_1^D\right) + K_1^H G_1^H\left(c_1^D\right)}{K_2^H G_2^H\left(c_2^D\right)}. \tag{2}$$

- $f = \frac{\lambda}{1+\lambda}$ and is increasing λ.

- How λ^e is affected by changes in capital?

Technology Diffusion

- If there is no technology diffusion, a firm in type s draw its cost c from a distribution given by

$$\bar{G}^s(c) = \left(\frac{c}{c^{M,s}}\right)^\theta, \ c \in [0, c^{M,s}], \quad s \in \{H, F\}$$

- $c^{M,F} \leq c^{M,H}$
- With technology diffusion in region 1, the domestic firms in region 1 draws from

$$G_1^H(c) = \left(\frac{c}{c_1^{M,H}}\right)^\theta, \ c \in [0, c_1^{M,H}],$$

where

$$c_1^{M,H} = c^{M,F} + e^{-\beta K^F}\left(c^{M,H} - c^{M,F}\right), \quad \beta > 0.$$

- If $K^F = 0$, $c_1^{M,H} = c^{M,H}$, and if $K_1^F \to \infty$, $c_1^{M,H} = c^{M,F}$.

Firms' Problems

- The market structure is monopolistic competition.
- Maximizing $\pi_i = \pi_{ii} + \pi_{ij}$ is equivalent to

$$\max_{p_{ij}} \pi_{ij} = \bar{L}_j \left(p_{ij} - \tau_{ij} c \right) q_{ij} \qquad \text{for } j = 1, 2.$$

- Prices and quantities

$$\begin{aligned} p_{ij} &= \frac{\varepsilon_{ij}}{\varepsilon_{ij} - 1} \tau_{ij} c = \frac{p_{ij}}{2p_{ij} - p_j^m} \tau_{ij} c = \frac{1}{2} \left(p_j^m + \tau_{ij} c \right), \qquad (3) \\ q_{ij} &= \frac{p_j^m}{\gamma} - \frac{p_{ij}}{\gamma} = \frac{1}{2\gamma} \left(p_j^m - \tau_{ij} c \right). \end{aligned}$$

Firms' Problems

- Let c_i^D and c_i^X denotes cutoff cost levels in the local market and export market for firms in region i.

- These cutoffs are independent of firm types $s = H, F$.

- Equilibrium profit and revenue for a firm from i with c in market j (if it sells there) is

$$\begin{aligned} \pi_{ij} &= \frac{\bar{L}_j}{4\gamma}\left(c_j^D - \tau_{ij}c\right)^2 \\ s_{ij}(c) &= \frac{1}{4\gamma}\left(\left(c_j^D\right)^2 - (\tau_{ij}c)^2\right). \end{aligned} \tag{4}$$

- A firm's mark-up in market j (if selling there at all) is

$$\mu_{ij}(c) = p_{ij}(c) - \tau_{ij}c = \frac{1}{2}\left(p_j^m - \tau_{ij}c\right). \tag{5}$$

Firms' Problems

- The number of products available in region i:

$$N_i = \frac{2(\theta+1)\gamma}{\eta}\frac{\alpha - c_i^D}{c_i^D}. \tag{6}$$

- Let $\rho \equiv \tau^{-\theta}$, and thus, ρ is a measure of trade openness.
- Each firm's expected profit gross of capital rental is:

$$\begin{aligned} E(\pi_i^s) &= \int_0^{c_i^D} \pi_{ii}^s(c)\, dG_i^s(c) + \int_0^{c_i^X} \pi_{ij}^s(c)\, dG_i^s(c) \\ &= \frac{\bar{L}_i \left(c_i^D\right)^{\theta+2} + \rho \bar{L}_j \left(c_j^D\right)^{\theta+2}}{2\gamma(\theta+1)(\theta+2)\left(c_i^{M,s}\right)^{\theta}} \end{aligned} \tag{7}$$

- Competition for capital equates the capital rental rate to the above expected profit. That is,

$$r_i^H = E\left(\pi_i^H\right), \qquad r_1^F = E\left(\pi_1^F\right). \tag{8}$$

Equilibrium with Fixed Spatial Distribution of Firms

For a given λ, the two cutoffs c_1^D and c_2^D are determined by the following equilibrium conditions.

$$\frac{\alpha - c_1^D}{\left(c_1^D\right)^{\theta+1}} = \frac{\left[\rho\left(c_1^D\right)^{\theta} + \lambda\left(c_2^D\right)^{\theta}\right]\left[K^F\left(\frac{c_1^{M,H}}{c^{M,F}}\right)^{\theta} + K^H\right]}{\lambda\left(c_2^D c_1^{M,H}\right)^{\theta} + \left(c_1^D c_2^{M,H}\right)^{\theta}} \frac{\eta}{2(\theta+1)\gamma},$$

$$\frac{\alpha - c_2^D}{\left(c_2^D\right)^{\theta+1}} = \frac{\left[\left(c_1^D\right)^{\theta} + \lambda\rho\left(c_2^D\right)^{\theta}\right]\left[K^F\left(\frac{c_1^{M,H}}{c^{M,F}}\right)^{\theta} + K^H\right]}{\lambda\left(c_2^D c_1^{M,H}\right)^{\theta} + \left(c_1^D c_2^{M,H}\right)^{\theta}} \frac{\eta}{2(\theta+1)\gamma}.$$

Equilibrium Spatial Distribution of Firms

- An equilibrium λ is such that
  $\Delta^H(\lambda) \equiv E\left(\pi_1^H(\lambda)\right) - E\left(\pi_2^H(\lambda)\right) = 0$, which implies
  $r_1^H = r_2^H \equiv r^H$.

- The equilibrium condition $\Delta^H = 0$ implies that

$$\frac{c_2^D}{c_1^D} = \left(\frac{\left(c_2^{M,H}\right)^\theta - \rho\left(c_1^{M,H}\right)^\theta}{\left(c_1^{M,H}\right)^\theta - \rho\left(c_2^{M,H}\right)^\theta} \right)^{\frac{1}{\theta+2}} :\equiv h > 1. \tag{9}$$

- Equilibrium c_1^D is uniquely determined by

$$\frac{\alpha(1+h) - c_1^D\left(1+h^2\right)}{\left(c_1^D\right)^{\theta+1}} = \frac{K^H + K^F\left(\frac{c_1^{M,H}}{c^{M,F}}\right)^\theta}{\left(c_1^{M,H}\right)^\theta - \rho\left(c_2^{M,H}\right)^\theta} \frac{\eta\left(1-\rho^2\right)}{2(\theta+1)\gamma}. \tag{10}$$

Equilibrium Spatial Distribution of Firms

Proposition 1: Let h be defined by (9). For any FDI level K^F such that $\rho^{\frac{1}{\theta}} < \frac{c_1^{M,H}}{c_2^{M,H}} < 1$ and

$$\frac{K^H + K^F \left(\frac{c_1^{M,H}}{c^{M,F}}\right)^{\theta}}{\left(c_1^{M,H}\right)^{\theta} - \rho \left(c_2^{M,H}\right)^{\theta}} \frac{\eta\left(1-\rho^2\right)}{2\left(\theta+1\right)\gamma} > \frac{\alpha\left(h^{\theta+1} - h^{\theta}\right)}{\alpha^{\theta+1}},$$

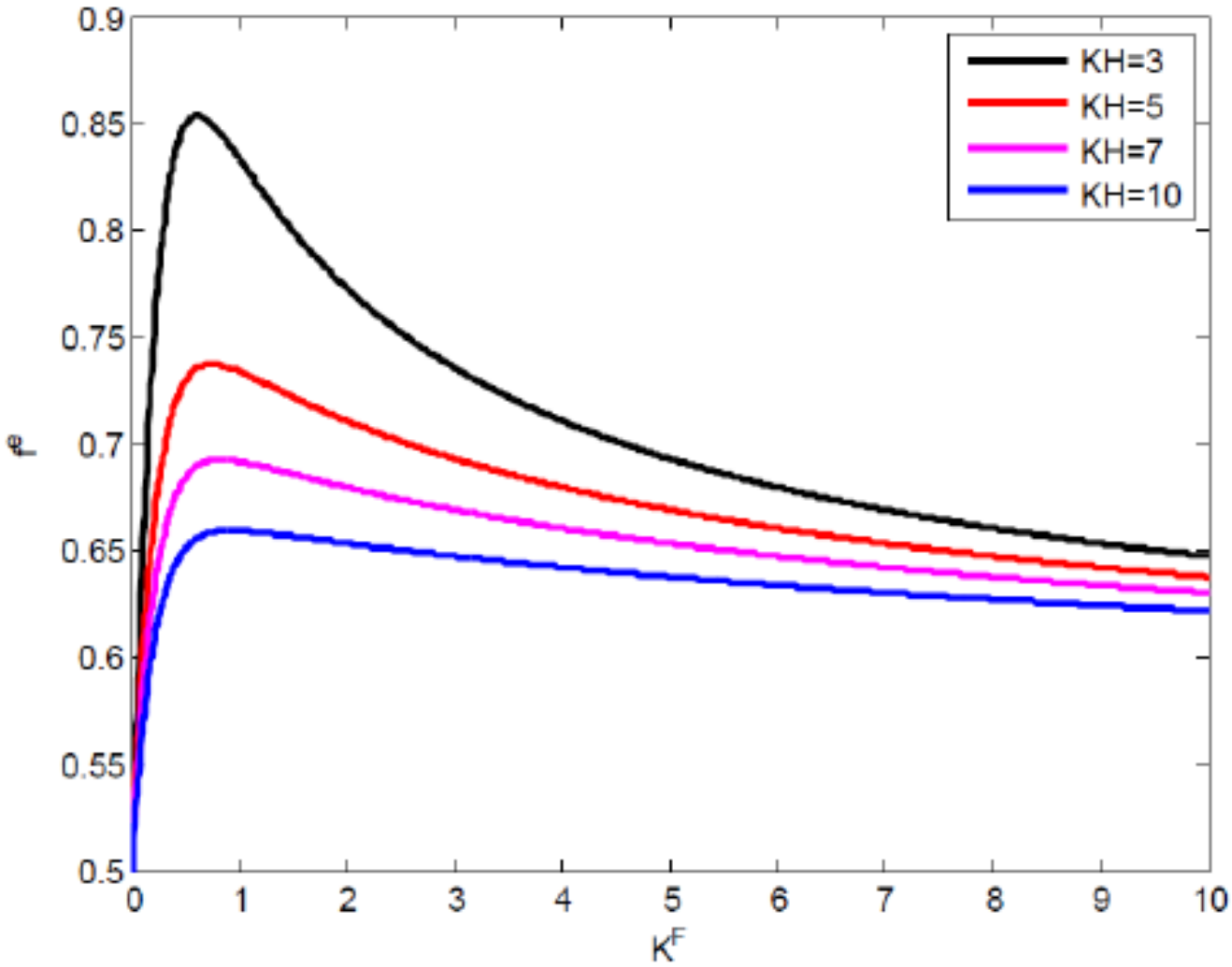
there exists one and only one partial-agglomeration equilibrium which is defined by $\lambda^e > 1$. When $\frac{c_1^{M,H}}{c_2^{M,H}} < \rho^{\frac{1}{\theta}}$, full-agglomeration always occurs in region 1.

Equilibrium Spatial Distribution of Firms

- If $\rho = 1$ ($\tau = 1$), competition pressure is the same regardless where you are located.
- ρ inversely measures how locations matter in terms of competition pressure.
- Given K^F, high ρ induces dispersion.
- Given $\rho \in (0, 1)$, increasing K^F may switch the equilibrium from partial to a full agglomeration.

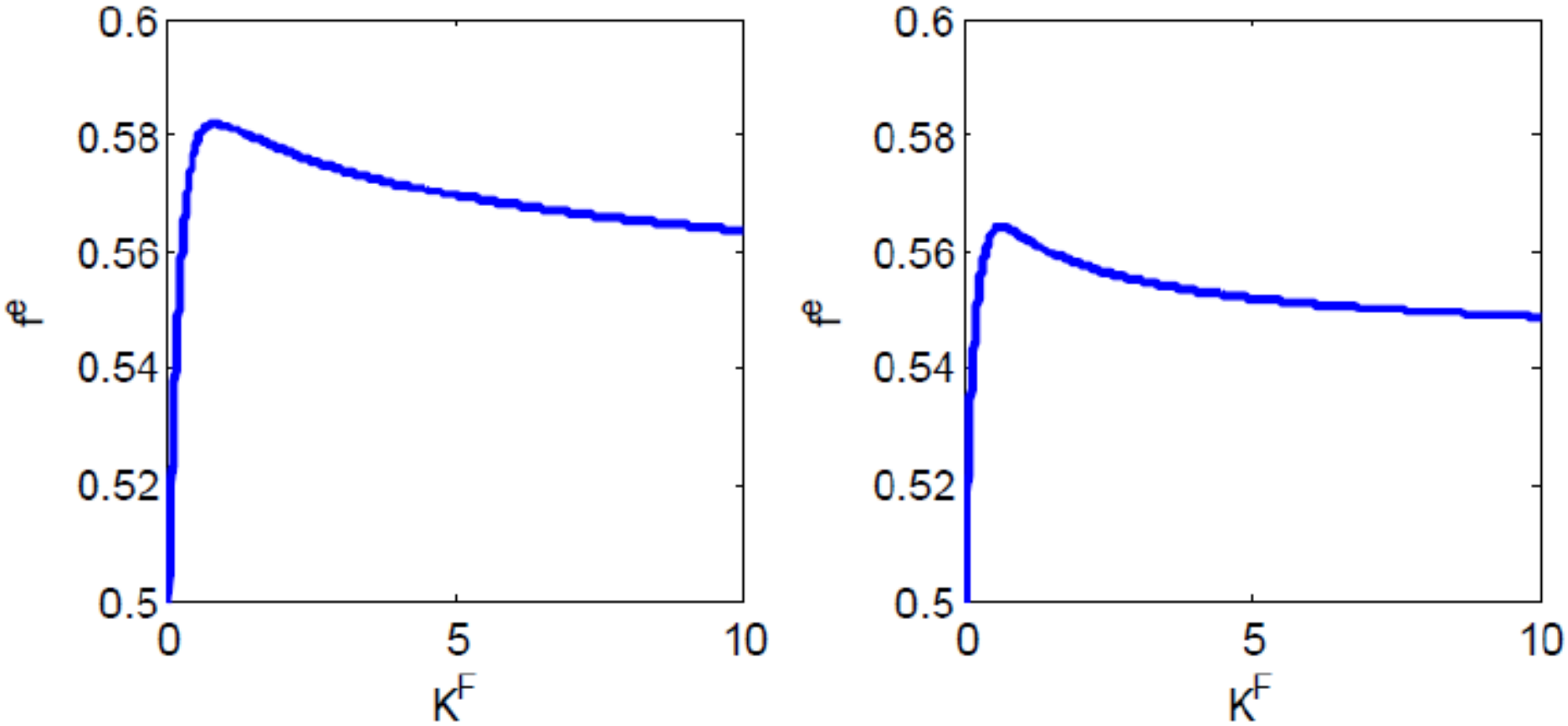
Equilibrium Spatial Distribution of Firms

Figure 3: The effect of K^F on f^e



Equilibrium Spatial Distribution of Firms

Figure 4: The effect on f^e when both K^F and K^H grow



Mechanism Tests

- A crucial element in our model is that the FDI deregulation generates a competition effect, which reduces firm markups, profits, and sales.

- To lend support to our theoretical model, we empirically test whether there are negative effects of FDI deregulation on markups, profits, and sales

$$y_{fit} = \alpha_f + \beta\, Treatment_i \times Post2002_t + \mathbf{X}'_{fit}\boldsymbol{\lambda} + \gamma_t + \varepsilon_{fit}$$

- Exporters vs. non-exporters. The non-exporters face predominantly the domestic competition pressure, whereas the exporters also face competition on foreign turf.

    - Hence, we expect that the competition effect of FDI deregulation is more pronounced for the non-exporters than the exporters.

Mechanism Tests

- What if the foreign firms mostly produce for export instead of selling on the domestic market and thus do not actually impose competitive pressure on domestic firms.

- The export intensity in each group before and after 2002.

	Before 2002	After 2002
Treatment Group	0.327	0.348
Control Group	0.398	0.400

- The FDI deregulation has no significant influence on the foreign firms' export intensity (See Table 6).

Mechanism Tests

Table 5: Mechanism Test I

	(1)	(2)	(3)
Dependent variable:	Log markups	Log profits	Log sales
Panel A. Full sample			
Treatment × Post02	−0.041***	−0.034***	−0.023***
	(0.014)	(0.012)	(0.006)
Observations	1,724,823	1,429,489	1,761,629
Panel B. Domestic firms sample			
Treatment × Post02	−0.037***	−0.035***	−0.025***
	(0.013)	(0.012)	(0.006)
Observations	1,363,524	1,152,490	1,395,898
Additional controls:			
Firm fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes
Control for determinants of FDI regulation changes	yes	yes	yes
Control for tariff reductions	yes	yes	yes
Control for SOE reforms	yes	yes	yes
Control for special economic zones	yes	yes	yes
Control for western development program	yes	yes	yes
Control for time-varying industry characteristics	yes	yes	yes
Control for vertical FDI	yes	yes	yes
Control for time-varying firm characteristics	yes	yes	yes

Mechanism Tests

Table 6: Mechanism Test II

Dependent variable:	Industrial agglomeration (EG index)		Export intensity (foreign firms)	Industrial agglomeration (EG index)
	Non-exporters	Exporters		Foreign firms
	(1)	(2)	(3)	(4)
Treatment × *Post02*	−0.025***	−0.011	0.011	−0.003
	(0.009)	(0.012)	(0.019)	(0.010)
Observations	4,057	3,851	3,995	3,653
Additional controls:				
Industry fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
Control for determinants of FDI regulation changes	yes	yes	yes	yes
Control for tariff reductions	yes	yes	yes	yes
Control for SOE reforms	yes	yes	yes	yes
Control for special economic zones	yes	yes	yes	yes
Control for western development program	yes	yes	yes	yes
Control for time-varying industry characteristics	yes	yes	yes	yes
Control for vertical FDI	yes	yes	yes	yes

Political Spatial Competition?

- Local governments have an incentive to lure business to help increase GDP and employment; such incentives could be particularly strong because of the potential for spillovers.
- FDI deregulation opens up new opportunities for the local governments to try to get FDI in the newly-deregulated industries.
- In this spatial political competition, less-agglomerated and less-developed regions may have been particularly keen to seize this new opportunity, causing dispersion.
- To test this story, we focus on the location pattern of foreign firms.
- The FDI deregulation has no significant influence on the EG index for the foreign firms (Column 4 of Table 6).

How Does Industrial Agglomeration Matter?

- We have shown empirically that around 2002, the FDI deregulation causes industries to disperse, in general.
- Is FDI deregulation condusive to industrial growth? (the technology diffusion channel)
- Consider standard agglomeration economies that could generate an innate agglomeration, e.g., **productivity spillovers**, input-output linkages, labor pooling, etc.
    - More agglomeration leads to larger industrial growth.
- Do we see this in the data?

How Does Industrial Agglomeration Matter?

- Industrial growth rate measured by the difference in the logarithm of value-added between t and $t-1$ for one-year growth rate, and that between t and $t-3$ for three-year growth rate).
- Regress industrial growth rate on on FDI deregulation using the same specification as in our baseline estimation – get $\hat{\beta}^{total}$.
- Run the same regression with an industrial agglomeration (EG index) as an additional control – $\hat{\beta}^{net}$.
- The relative contribution of the industrial agglomeration to the total effect of FDI deregulation on economic growth as $\left|\frac{\hat{\beta}^{total}-\hat{\beta}^{net}}{\hat{\beta}^{total}}\right|$.

How Does Industrial Agglomeration Matter?

Table 7: Role of Industrial Agglomeration in Industrial Growth

	Estimated coefficient of *Treatment* × *Post02*		Implied relative contribution
	EG index not included	EG index included	
Dependent variable:			
Growth rate of industry value-added	0.041*	0.049**	−19.27%
(difference in the logarithm of value-added between *t* and *t-1*)	(0.021)	(0.022)	
Growth rate of industry value-added	0.107*	0.124**	−16.62%
(difference in the logarithm of value-added between *t* and *t-3*)	(0.057)	(0.059)	
Additional controls:			
Industry fixed effects	yes	yes	–
Year fixed effects	yes	yes	–
Control for determinants of FDI regulation changes	yes	yes	–
Control for tariff reductions	yes	yes	–
Control for SOE reforms	yes	yes	–
Control for special economic zones	yes	yes	–
Control for western development program	yes	yes	
Control for time-varying industry characteristics	yes	yes	–
Control for vertical FDI	yes	yes	–

Conclusion

- Empirically, FDI negatively affect industrial agglomeration.
- We provide a theory based on technology diffusion and competition effects to explain such a result.
- The theory can account for both the agglomeration story of Shenzhen and our empirical results on FDI deregulation.

Conclusion

- Mechanism Tests:
  - Empirically, we do observe lower markups, profits, and sales in the deregulated industries post 2002.
  - The effect on non-exporters' agglomeration pattern is more pronounced than exporters.
  - Export intensity of foreign firms hardly change.
  - There is no support for the story of political spatial competition.

Conclusion

- FDI deregulation promotes industrial growth
- About 17% of industrial growth rate is lost due to the de-agglomeration caused by FDI de-regulation
    - which implies that agglomeration does contribute to industrial growth.
- These rationalize FDI-promoting and agglomeration-promoting policies, of which the combinations are special economic zones.