Network Expansion and Overhang: Entrepreneurship in China's Structural Transitions

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Introduction

- The first step in the process of economic development is the transition from agriculture to industry, which involves emergence of industrial entrepreneurship (besides movement of workers)
  - A large literature has examined constraints to entrepreneurship; e.g. wealth, education, talent, regulation (King and Levine, 1993; Banerjee and Newman, 1993; Levine and Rubinstein, 2017; De Mel et al., 2008)

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- A subsequent transformation features quality upgrading and the transition from domestic production to exporting
  - A more recent literature on trade and development has identified the same set of constraints in this second transition (Melitz, 2003; Manova, 2013; Allen, 2014; Atkin et al., 2017; Feenstra et al., 2014)

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- We examine these two successive transitions in the context of the Chinese development experience since 1990

1. Introduction: Structural Transformation in China

- The transition out of agriculture in China commenced in the 1980's with the establishment of TVE's and accelerated with the emergence of private firms in the 1990's
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  - Proportion of homegrown private firms grew from near 0 in 1990 to over 90% in 2009 No. of firms Registered capital
- A decade later, China entered the WTO and thereafter Chinese exports grew sharply
  - However, homegrown firms were less dominant in this second transition No. of exporters Export revenue

Entrepreneurship in China

- A distinguishing feature of Chinese economic development is that it was relatively broad-based
  - Two-thirds of registered firms were established by entrepreneurs born in rural counties No. of firms Registered capital
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- Examine variations across counties with varying pre-industrial (1982) **population density**, a common measure of pre-industrial productivity and prosperity (caloric suitability) (Galor and Weil 2000, Galor and Ozak 2015)
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  - *Prosperity* versus *Scarcity* hypotheses
- In this paper we examine how the two stages of structural transformation varied across counties of varying population density

2. Data Sources

1. *Population density and other demographics:* Census 1982, 1990, 2000
2. *Firm Registration:* SAIC Registration Database - universe of registered firms (1994-2009), includes principal entrepreneurs' ID (birthplace, education etc), capital invested
3. *Firm Revenues:* Industrial Census 2004, 2008; SAIC Inspection Data - firm panel for sample from 24 provinces, 1998-2009
4. *Exports:* Customs Data (2002-2009)

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   - Compare capital intensity of indirect exporters, direct exporters, and domestic producers

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- Since we are interested in transition to high value production/exports, we restrict attention to direct exports (i.e., in contrast to indirect exports-or-domestic sales)

3. Facts: Stylized Fact No. 1 (Entrepreneurial Propensity)

- The propensity to become an entrepreneur, conditional on observed measures of ability (education, occupation and industry structure), is increasing in population density (predicted by FAO-GAEZ potential crop yields at county level)

Firm entry by period | Entrepreneurial propensity: PD coefficient

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- Consistent with the prosperity hypothesis and a standard Roy model where higher population density counties were characterized by higher average (unobserved) entrepreneurial 'ability'
- We would then expect to see (a la Melitz 2003) that entrepreneurs from higher population density counties were also more likely to transition to exports after China joined the WTO

Stylized Fact No. 2 (Export Propensity)

- This, however, does not appear to be the case!
- The propensity to become an exporter, conditional on the same covariates, was **decreasing** in (predicted) population density Exporter/population: PD coefficient

Stylized Fact No. 2 (Export Propensity)

- This, however, does not appear to be the case!
- The propensity to become an exporter, conditional on the same covariates, was **decreasing** in (predicted) population density Exporter/population: PD coefficient
- Explaining this puzzle is the main objective of this paper

Added Complication:Stylized Fact No. 3 (Negative Selection)

- Explanations based on Roy-Melitz models are based on correlation of population density with (unobserved) entrepreneurial ability
- If population density matters only by shifting the ability distribution, the entry threshold for ability does not vary with population density
- This implies that the size and productivity of the marginal entrant does not vary with population density of the entrepreneur's origin county

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- However, what we see instead is more negative selection into business from high population density counties

Marginal education and capital

Explaining Facts 1-3

- Fact 3 indicates that birth county population density must affect other parameters: e.g., opportunities in the traditional and modern occupation
  - Must reflect higher payoffs in business (relative to traditional occupations) for entrepreneurs born in high density counties
- Explaining coexistence of Facts 1 and 2 then requires payoff advantages on the domestic market of high population density origins must be reversed in exporting
  - For example, entrepreneurs from higher population density counties have skills or connections more useful in domestic production, and less useful in exporting

Stylized Fact No. 4

- However, this explanation is at odds with Fact no. 4:
- Revenues and productivity (TRP) grew faster for entrepreneurs from high density counties, after controlling for selection (firm fixed effects, as well as sector-location dummies) Revenue,TFP and population density

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- We provide an explanation based on network spillovers between entrepreneurs originating from the same birth county

A Network-Based Explanation

- Underdeveloped markets and weak property rights give rise to problems with access to reliable suppliers, capital, insurance, knowhow, marketing channels, all of which are critical for entrepreneurial success
- This creates a role for informal mechanisms based on reputation and trust in community networks:
  - In China: Peng 2004, Allen, Qian and Qian 2005, Greif and Tabellini 2017
  - other LDCs: McMillan-Woodruff 1999, Fafchamps 2003, Fisman 2003, Banerjee-Munshi 2004, Munshi 2011

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  - other LDCs: McMillan-Woodruff 1999, Fafchamps 2003, Fisman 2003, Banerjee-Munshi 2004, Munshi 2011
- In China, networks are organized around birthplace (e.g., chambers of commerce (*yidi shandui*) comprising entrepreneurs from same origin)
- In contrast to agglomeration spillovers, network spillovers at any location are restricted to entrepreneurs from the same birthplace

Network Ties and Population Density

- It is plausible to suppose higher population density counties are characterized by stronger network ties, because:
  - Networks from higher population density counties (not cities) exhibit greater trust in neighbors (not strangers)
    Trust and population density: China | Trust and population density: cross country
  - Stronger cross-ownership homophily among entrepreneurs from higher p counties, among both domestic producers and exporters Homophily and population density, domestic firms
    Homophily and population density, exporters
  - Greater tendency for entrepreneurs from higher p counties to concentrate within specific locations and sectors, for both domestic producers and exporters
    Concentration and population density, domestic firms
    Concentration and population density, exporters

How Does the Network-based Explanation Work?

- Our explanation is based on conjunction of:
  - network-based spillovers rising in origin p
  - diseconomies of scope
- Latter states that an entrepreneur incurs higher costs in managing production simultaneously for domestic and export markets (which typically require different plants)
- These encourage specialization either on the domestic or export market

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- In the Chinese data, there are three types of firms: domestic producers, "pure" exporters, and "mixed" exporters

Types of Firms, by Activity

  - 12.4% of exporters in 2004 and 16.8% of exporters in 2008 are pure exporters
- Cannot be explained by a Melitz model owing to lack of scope diseconomies

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  - The marginal exporter specializes in exports, and is indifferent between specializing in exports and domestic production
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  - Positive spillovers on both domestic and export markets explain Facts 3 and 4

Evidence of Network-Based Spillovers

- Test spillover hypothesis: revenue/productivity

$$\ln y_{ijk,t} = (\theta_0 + p_j\theta_p) \ln n_{jk,t-1} + \gamma lnK_{i0} \cdot t + f_i$$

of firm i located in prefecture k, entrepreneur from birth county j (with pop density p_j, lagged network size $n_{jk,t-1}$)

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  of firm i located in prefecture k, entrepreneur from birth county j (with pop density p_j, lagged network size $n_{jk,t-1}$)

- Shift-share 'instrument' for lagged network size $n_{jk,t-1}$, similar to Imbert et al 2022:

- Predicted agricultural income shocks in the origin county for previous five years, constructed as follows:
  - extract residuals from AR(1) regressions of world prices of 11 major crops
  - weight by crop value shares in each county
  - multiply by a factor decreasing in distance between origin j and location k

Evidence of Network-Based Spillovers, contd.

- To overcome sector-location selection concerns and to control for agglomeration effects, outcome variable is within-sector-location Z-score
- IV estimates show total revenues and exporting revenues were both increasing in population density interacted with (predicted) lagged network size, after controlling for firm fixed effects and initial capital Revenue, TFP, and PD × network size

Direct Evidence of Network-Based Spillovers: discussion

- Exclusion restriction is invalid if lagged crop price shocks affect wealth
- However, first stage results show higher network size result from *negative* crop income shocks
- Hence IV estimates of network benefits are downward biased
- IV results are robust to checks recommended by Goldsmith-Pinkham et al 2020

Rest of the Paper

- Model that formalizes the network-cum-scope-diseconomy hypothesis, how it explains the four facts Model
- Specifically, the 'network overhang ' effect: how a large domestic network discourages emergence of an export network when export opportunities arise
- Estimated network dynamics permits quantification of counterfactual changes in: Counter-factuals
  - network effects
  - advancing the date of China's WTO accession

  on growth of domestic and export networks

Counter-factual Analysis to Illustrate 'Network Overhang'

- A 10% reduction in the domestic network effects:
  - lowers the number of domestic firms in 2009 by 35%
  - raises the number of exporters by 52%
  - no effects on their respective growth rates over 2002-2009
- Advancing date of China's accession to WTO to earlier years (2000, 1998, 1996), assuming estimated export market sizes would have been the same as post-2002, to quantify the magnitude of the overhang effect on growth in number of exporters
- We find advancing accession date to 1996 would have resulted in a doubling of the number of exporters eight years later

Smaller Domestic Network

Conclusion

- We provide evidence and reasons for how a fast first stage of structural transformation (emergence of modern entrepreneurs) may retard subsequent stage (transition from domestic production to high value exports)
- Our explanation was based on a combination of network effects and diseconomies of scope
- Network-based growth was accompanied by two forms of misallocation: negative selection into entrepreneurship (static), slow rates of transition into exporting (dynamic)
- These dynamics are not specific to Chinese economic development; e.g. Munshi and Rosenzweig (2006) provide evidence from India how caste networks in urban labor markets earlier supported migration and later restricted it to newly emerging sectors

5. Counterfactuals

- Structural parameters of the model cannot be identified, given the data
- However, reduced form regressions can be used to predict the effect of counterfactual changes in certain parameters affecting network overhang (e.g., domestic network effects, alternative dates of WTO access)

$$\frac{n_t}{t} = A - \frac{\ln \zeta}{1-\sigma} + \frac{q_{dt} + (\theta_{d0} + p\theta_d) \ln n_{t-1}}{(1-\sigma)(1-\alpha)}$$

$$\begin{aligned} \frac{n_{et}}{t} &= A - \frac{\ln \gamma}{\delta - 1} \\ &+ \frac{1}{(\delta-1)(1-\alpha)t} \sum_{t' \leq t} [q_{et'} + (\theta_{e0} + p\theta_e) \ln n_{e,t'-1} \\ &- q_{dt'} - (\theta_{d0} + p\theta_d) \ln n_{t'-1}] \end{aligned}$$

- we can use these to predict the effect of an x% fall in θ_{d0}, θ_d on entry into entrepreneurship and exports respectively

Entrepreneurial and Export Propensity Regressions on Network Size

Propensity to become:	firms	exporters
	(1)	(2)
$PD \times \ln n_{jk,t-1}$	0.0082***	-0.0031**
	(0.0020)	(0.0013)
$PD \times \ln n_{ejk,t-1}$	–	0.0088**
		(0.0045)
$\ln n_{jk,t-1}$	0.0004***	0.0001
	(0.0001)	(0.0001)
$\ln n_{ejk,t-1}$	–	0.0001
		(0.0002)
Observations	370,143	3,197

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4. The Model: Assumptions

- Origin population density p
- Agent cohorts $t' = 1, \ldots, T$ of unit mass each
- Individual ability ω, with $\log \omega$ distributed uniformly on $[0, A]$
- Occupation choice at $t \geq t'$:
  - traditional occupation generating payoff ω^σ with $1 > \sigma > 0$
  - entrepreneurship in a given destination (sector-location): domestic production d and/or export production e
- Network size at t: n_t, all entrepreneurs; $n_{et} (\leq n_t)$ number of exporters; n_0, n_{e0} given

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Model Assumptions (contd.)

- *Profits:* (extending Melitz 2003)

$$\pi_{dt} = C_{dt}\omega^{1-\alpha}K_{dt}^{\alpha} - rK_{dt}$$

$$\pi_{et} = C_{et}\omega^{\delta(1-\alpha)}K_{et}^{\alpha} - r(1+l)K_{et}$$

with $\alpha \in (0,1); \delta > 1; r, l > 0$

- *Community TRP* : (extending Ciccone-Hall 1996)

$$\log C_{dt} = q_{dt} + (\theta_{d0} + p\theta_d) \ln n_{t-1}$$

$$\log C_{et} = q_{et} + (\theta_{e0} + p\theta_e) \ln n_{e,t-1}$$

(abstract from cross-network spillovers)

- *Market opportunities:* q_{dt}, q_{et} increasing in t, independent of p

Differences from Melitz Model

- *Irreversibility:* $K_{mt} \geq K_{m,t-1}, m = d, e$
- *No Exit:* $n_t \geq n_{t-1}, n_{et} \geq n_{e,t-1}$
- *Scope Diseconomy:* Fixed cost β if and only if $K_{dt}K_{et} > 0$
- *Myopia*
- Only the scope diseconomy assumption is critical

Recursive Nash Equilibrium

- Given suitable parameter restrictions, equilibrium involves sorting by ability thresholds for cohort t' agents at date $t \geq t'$:

$$0 < \omega^*_{dt} < \omega^*_{et'} < \omega^*_{mt} < 1$$

where:

  - those below ω^*_{dt} do not enter
  - in $(\omega^*_{dt}, \omega^*_{et'})$ specialize in d
  - in $(\omega^*_{et'}, \omega^*_{mt})$ specialize in e
  - above ω^*_{mt} enter both d and e

- Entry threshold $\omega^*_{et'}$ for export specialization varies with cohort t' but not with experience $t \geq t'$; *a large domestic network at* t' *raises* $\omega^*_{et'}$ (‘*overhang*’)
- Thresholds for entering domestic production and mixed exporting independent of cohort, falling over time

Entrepreneurship Dynamics

- *Entrepreneurial Propensity (NP):*

$$\frac{n_t}{t} = A - \frac{\ln \zeta}{1-\sigma} + \frac{q_{dt} + (\theta_{d0} + p\theta_d) \ln n_{t-1}}{(1-\sigma)(1-\alpha)}$$

- Solving recursively, NP rising in p
- Hence network effects explain greater propensity to enter business from high density origins (Fact 1)
- Entry threshold falling in p: explains negative selection into entrepreneurship (Fact 3)

Export Dynamics

- *Export Propensity (EP):*

$$\begin{aligned}\frac{n_{et}}{t} &= A - \frac{\ln \gamma}{\delta - 1} \\ &+ \frac{1}{(\delta-1)(1-\alpha)t} \sum_{t' \leq t} [q_{et'} + (\theta_{e0} + p\theta_e) \ln n_{e,t'-1} \\ &- q_{dt'} - (\theta_{d0} + p\theta_d) \ln n_{t'-1}]\end{aligned}$$

- The presence of a large domestic network reduces the incentive to enter exports (overhang effect)
- If this effect is large enough, EP could be decreasing in p (consistent with Fact 2)

Intensive Margin: Firm Revenue, Productivity Dynamics

- For entrepreneur with ability ω in home production:

$$\begin{aligned} \ln R_{dt} &= \frac{1}{1-\alpha}(\theta_{d0} + p\theta_d)\ln n_{t-1} + \ln\omega + q_{dt} + \psi \\ \ln P_{dt} &= (\theta_{d0} + p\theta_d)\ln n_{t-1} + (1-\alpha)[\ln\omega + q_{dt}] \end{aligned}$$

- ln exports:

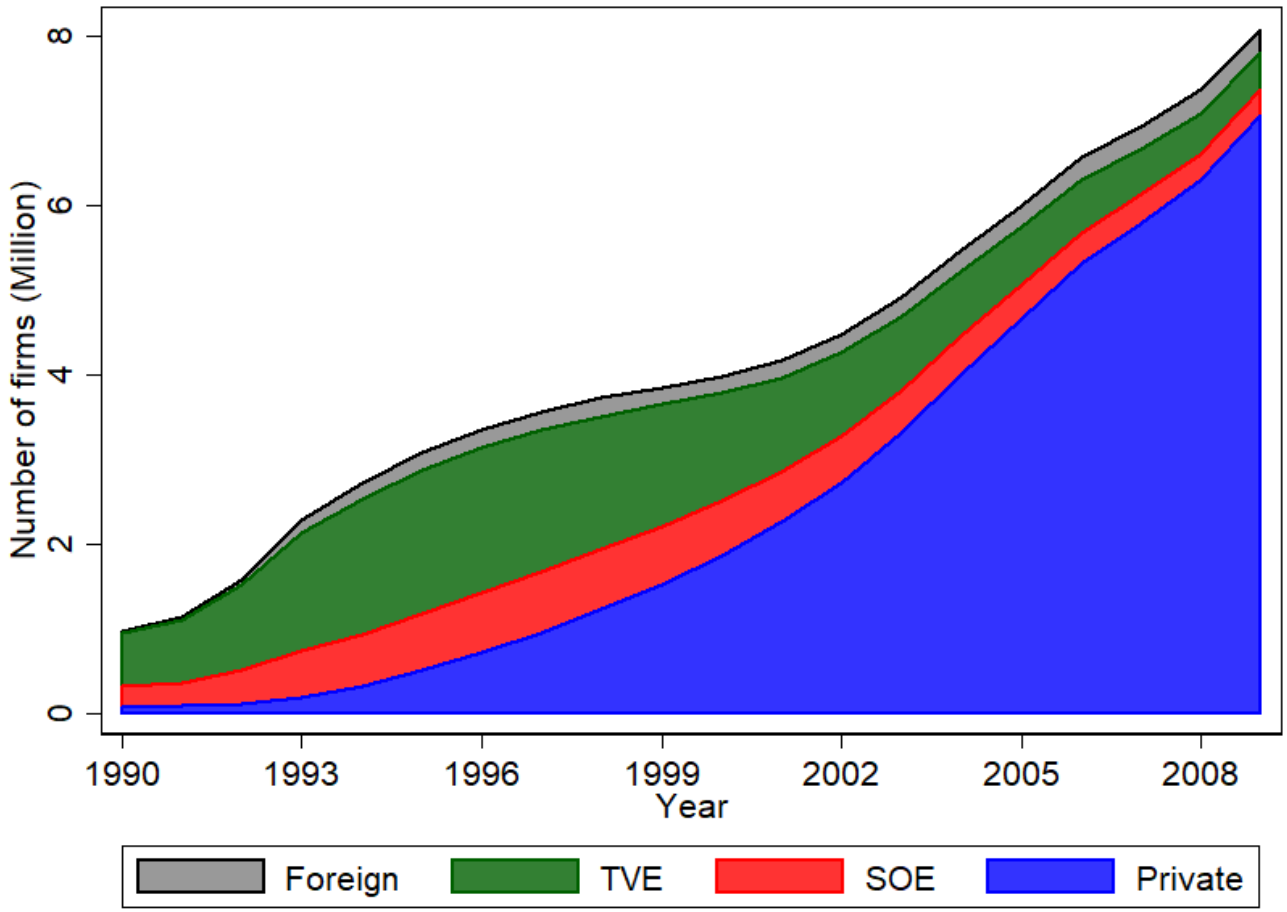
$$\begin{aligned} \ln R_{et} &= \frac{1}{1-\alpha}(\theta_{e0} + p\theta_e)\ln n_{e,t-1} + \delta q_{et} + \delta\ln\omega + \psi' \\ \ln P_{et} &= (\theta_{e0} + p\theta_0)\ln n_{e,t-1} + \delta(1-\alpha)[\ln\omega + q_{dt}] \end{aligned}$$

- Consistent with Fact 4 (IV results; also reduced form results because growth of export network is not significantly smaller for high p origin-entrepreneurs)

Alternative Sources of Heterogeneity

- Ability distribution (A in the model) varies across counties and over time, such that higher population density counties have an advantage in domestic production but are at a disadvantage in exporting
  - Can explain Fact 1 and Fact 2, but not negative selection or the revenue results with firm fixed effects
- Outside options are inferior in higher population density counties and worsening over time
  - Can explain Facts 1 and 3, but not Fact 2 or 4

Distribution of Firms, by Type



Source: SAIC registration database.

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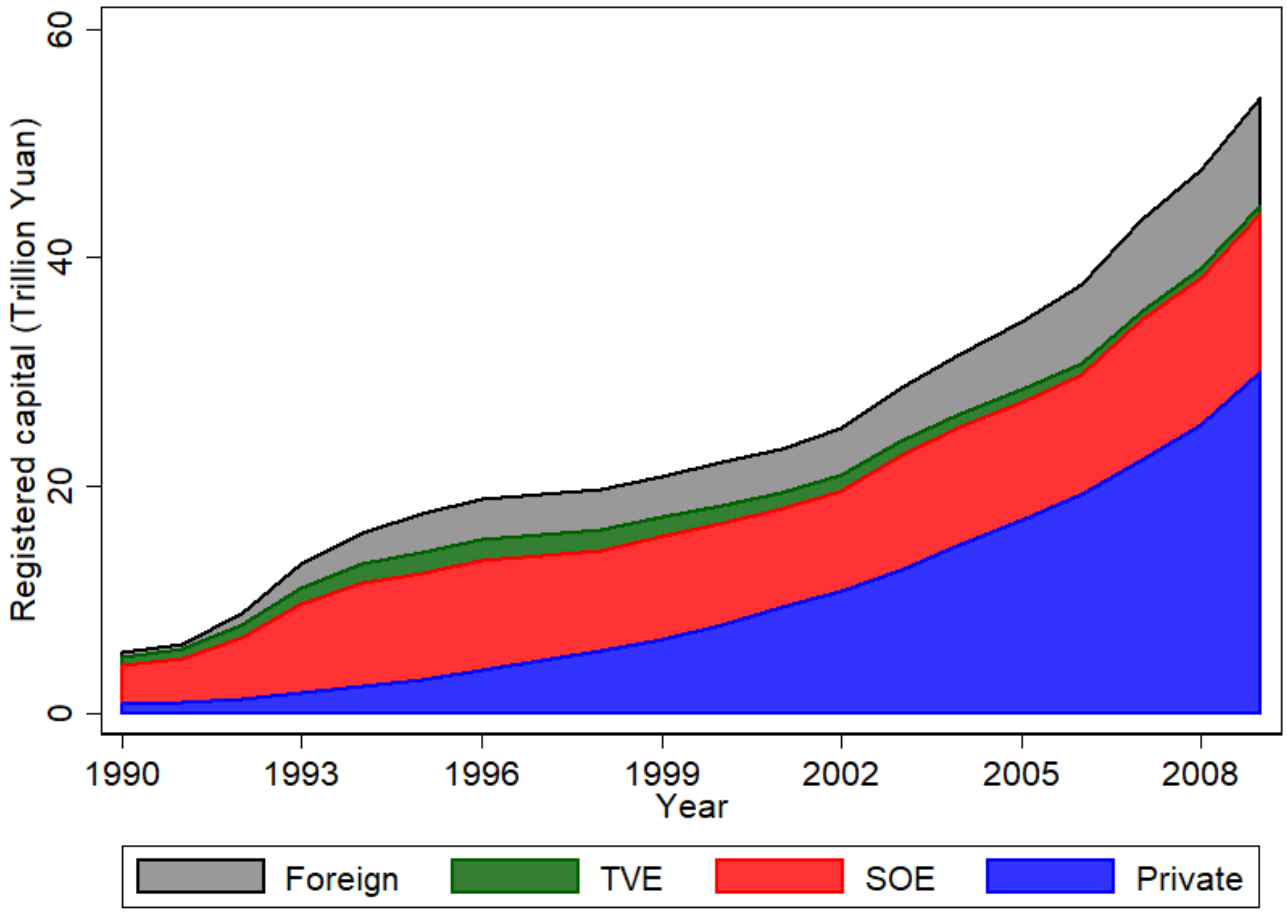
Distribution of Capital, by Type



Source: SAIC registration database.

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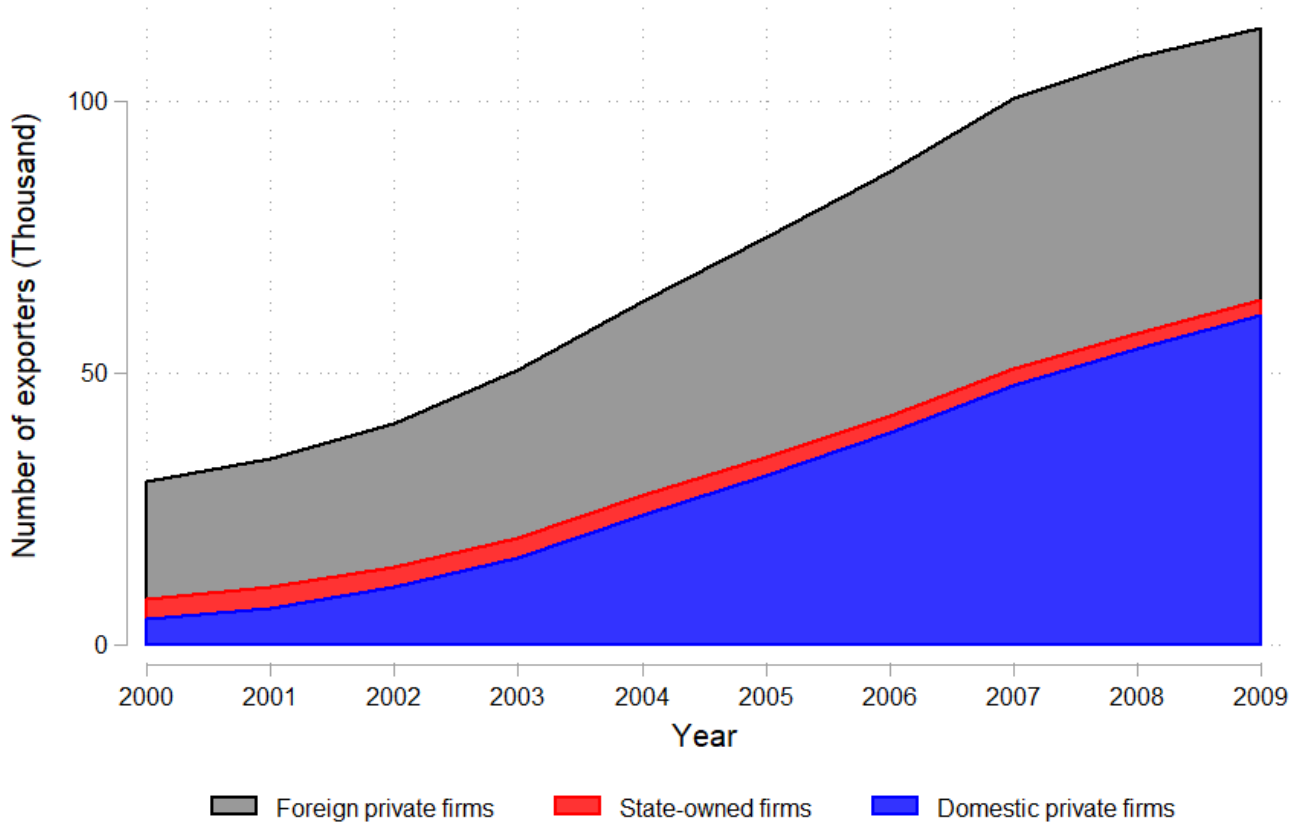
Number of Exporters, by Type



Source: SAIC registration database and Customs Data.

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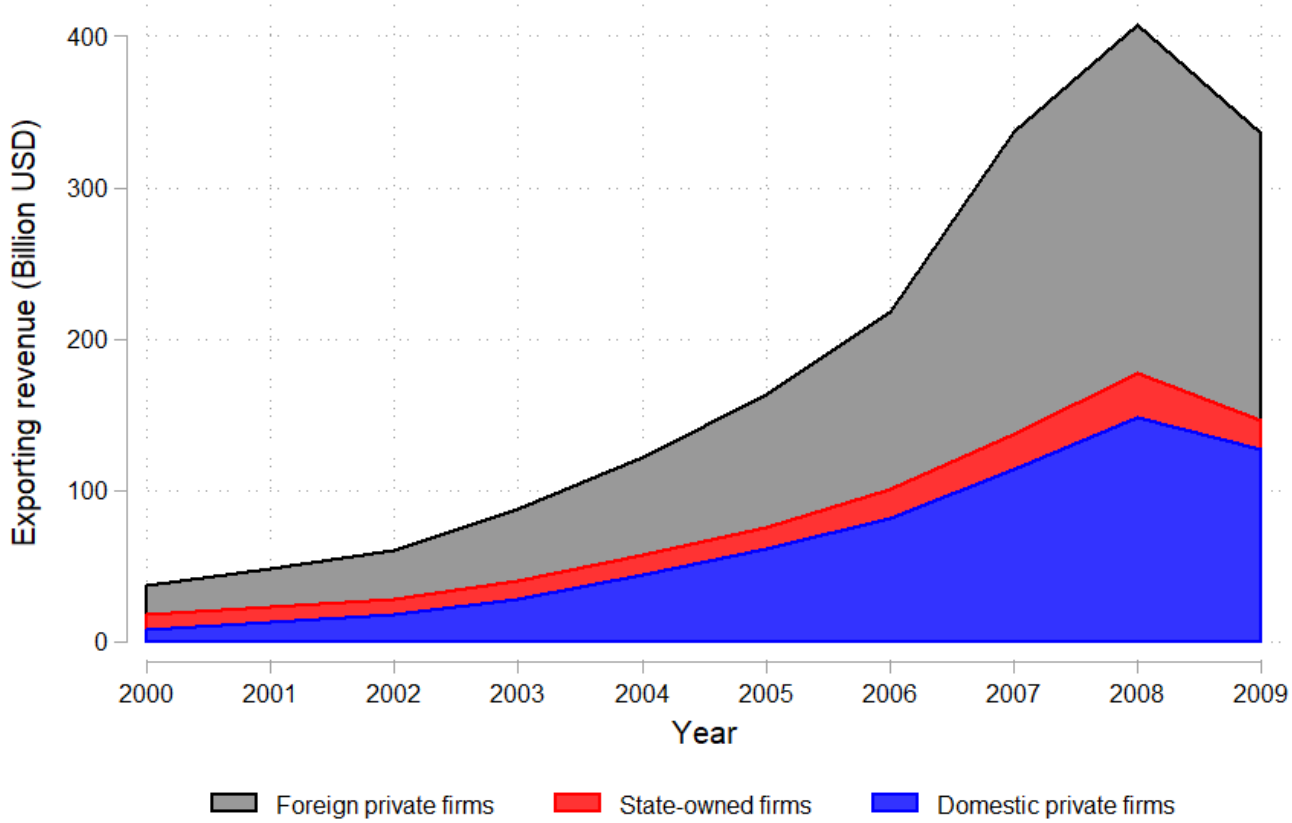
Export Revenue, by Type



Source: SAIC registration database and Customs Data.

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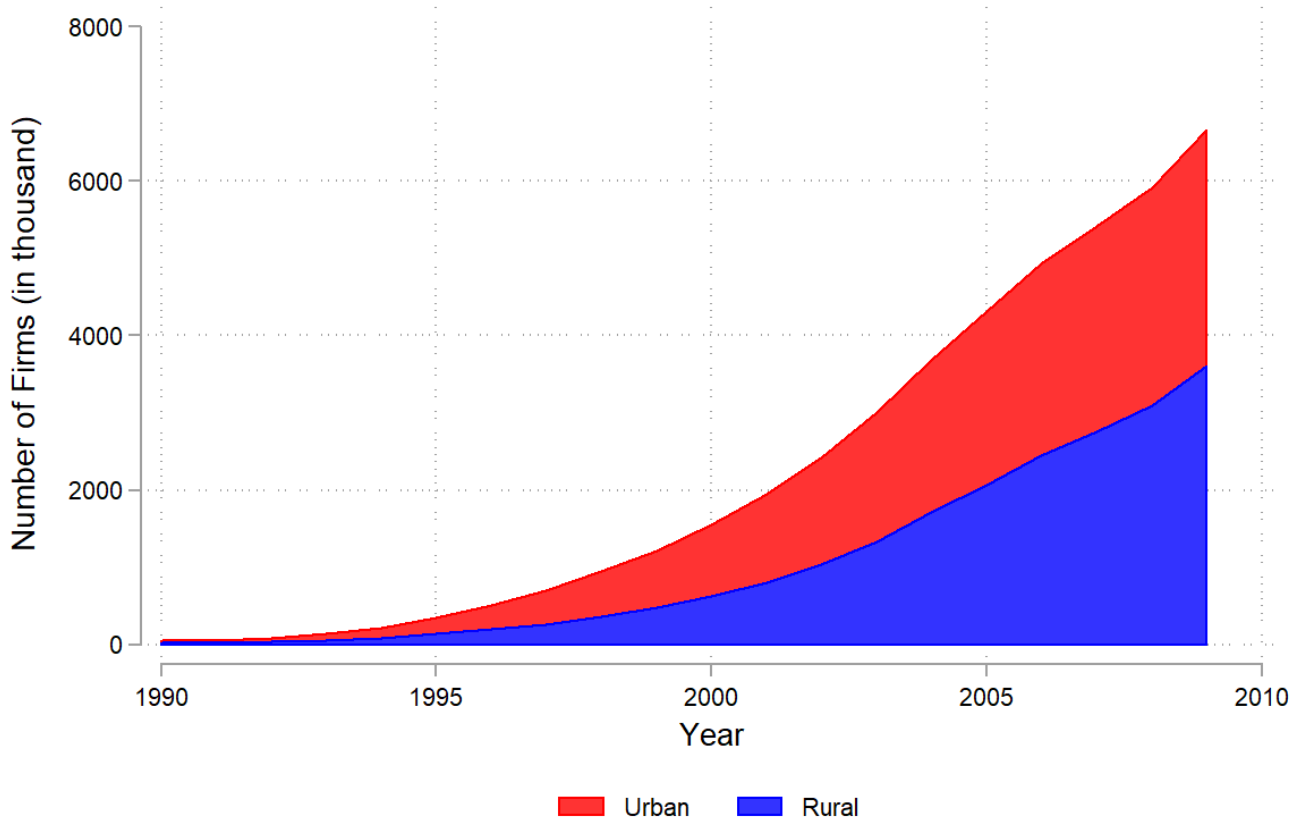
Number of Firms, by Rural and Urban Entrepreneur



Source: SAIC registration database.

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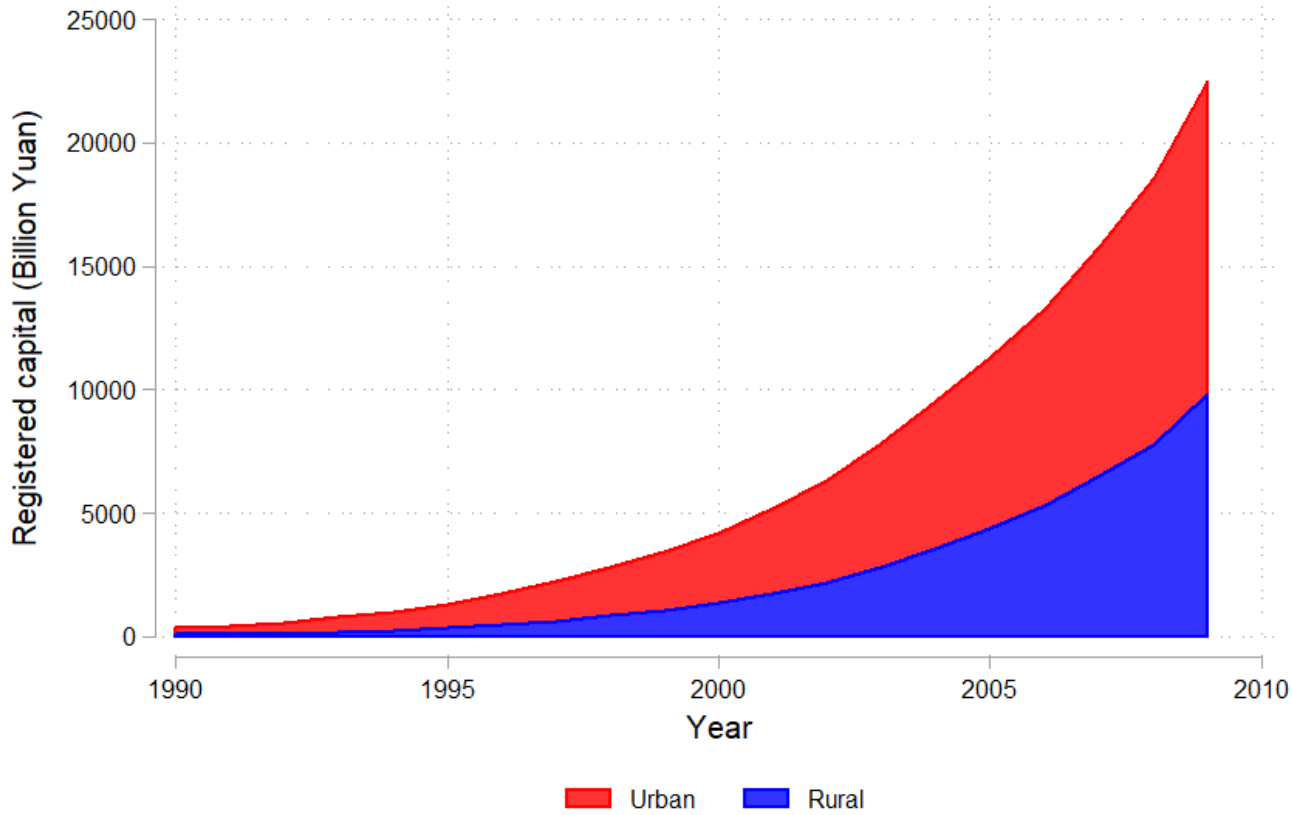
Registered Capital, by Rural and Urban Entrepreneur



Source: SAIC registration database.

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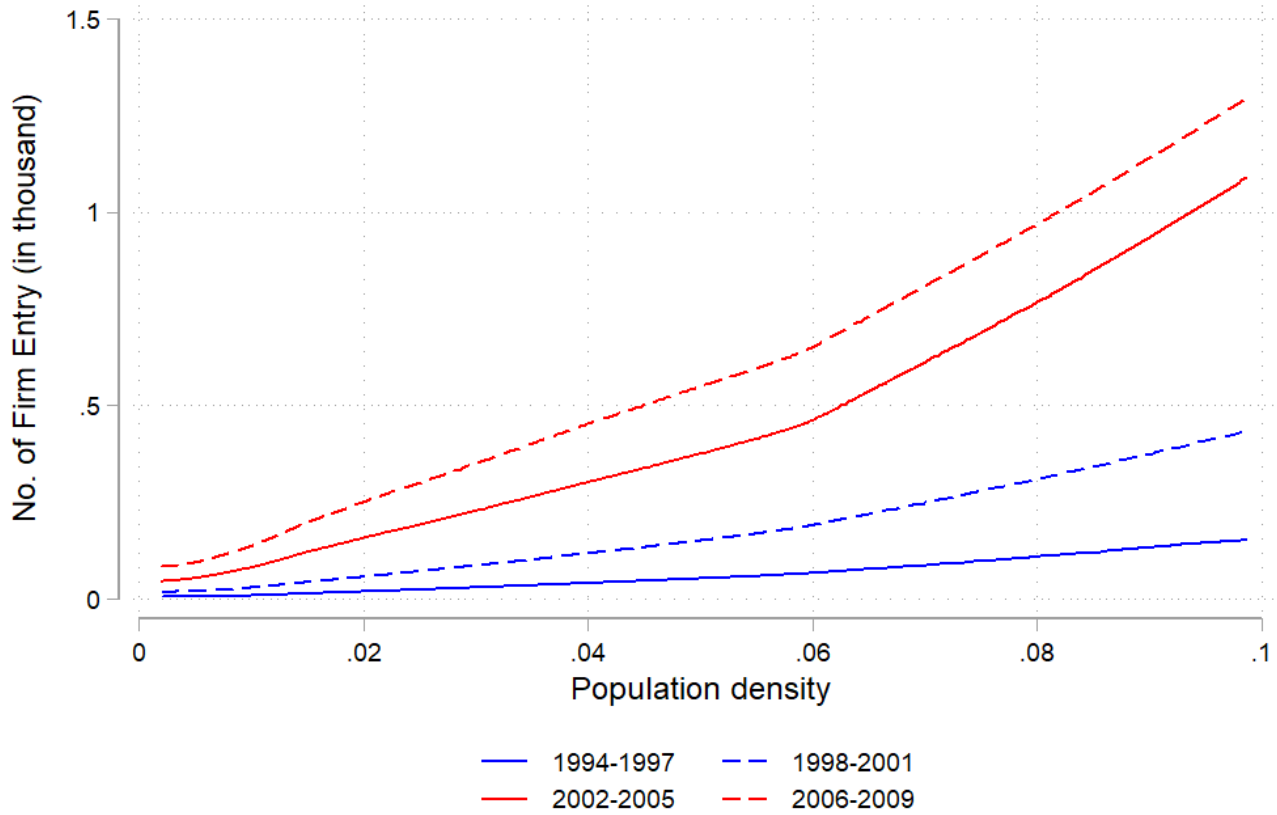
Firm Entry and Population Density



Source: SAIC registration database.

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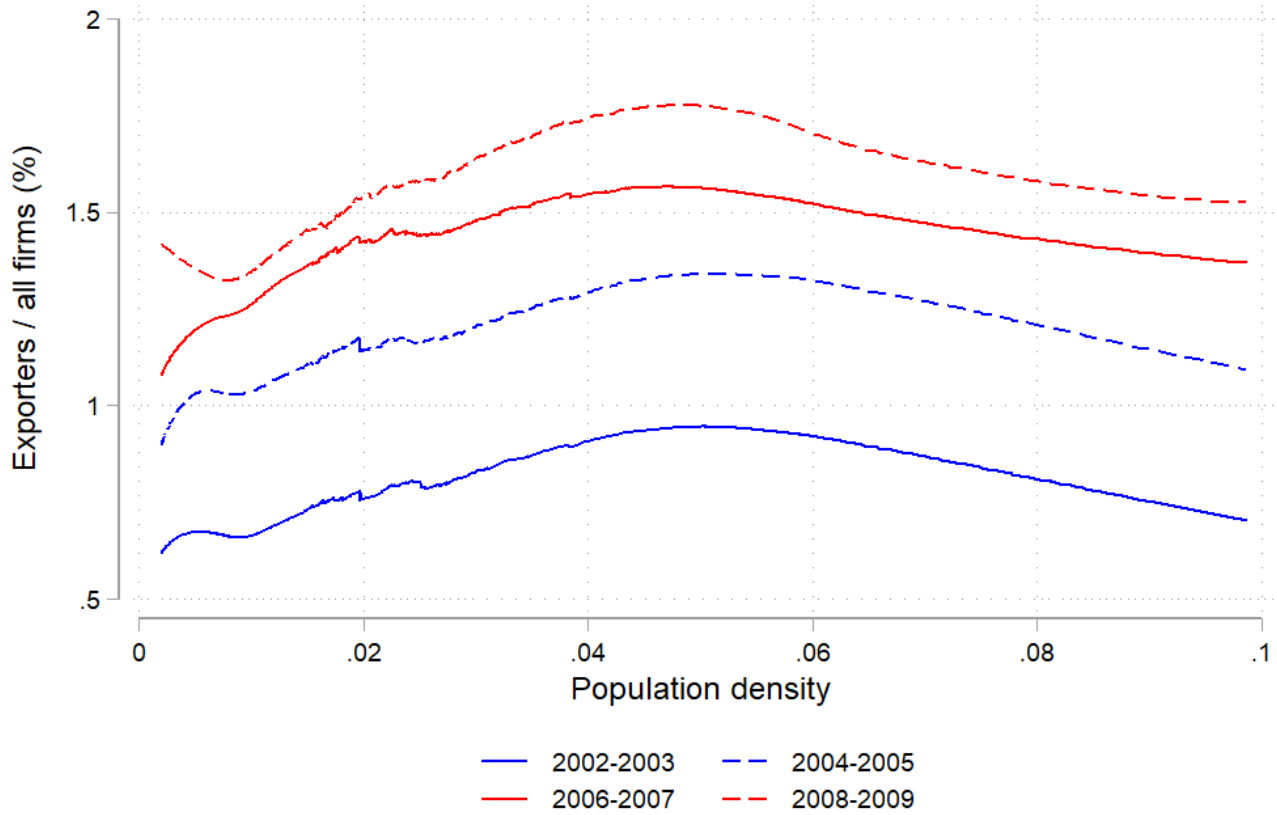
Fraction of Exporters and Population Density



Source: SAIC registration database and Customs Data.

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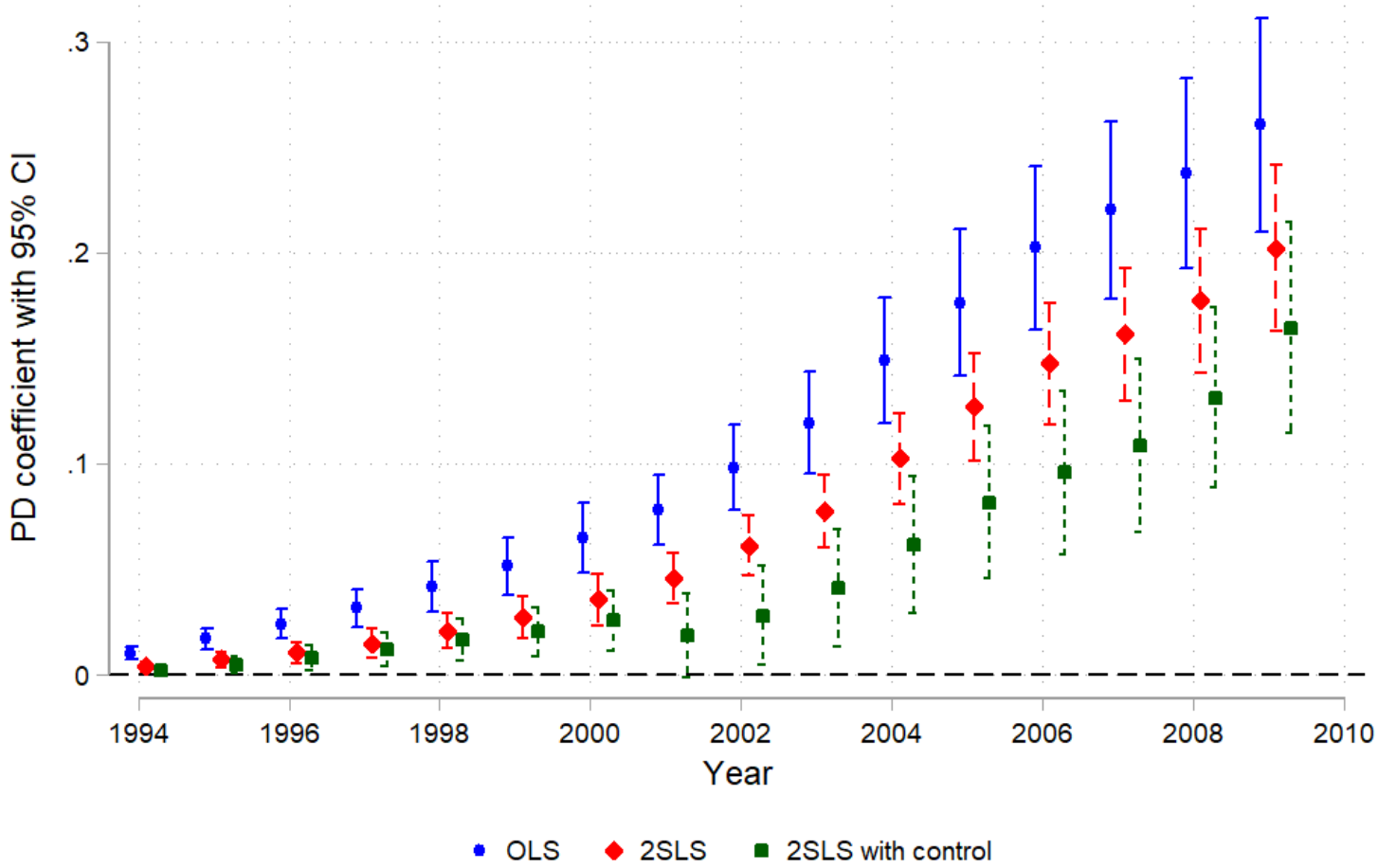
Propensity to Become An Entrepreneur: PD coefficient by year



Source: SAIC registration database and Population Census.

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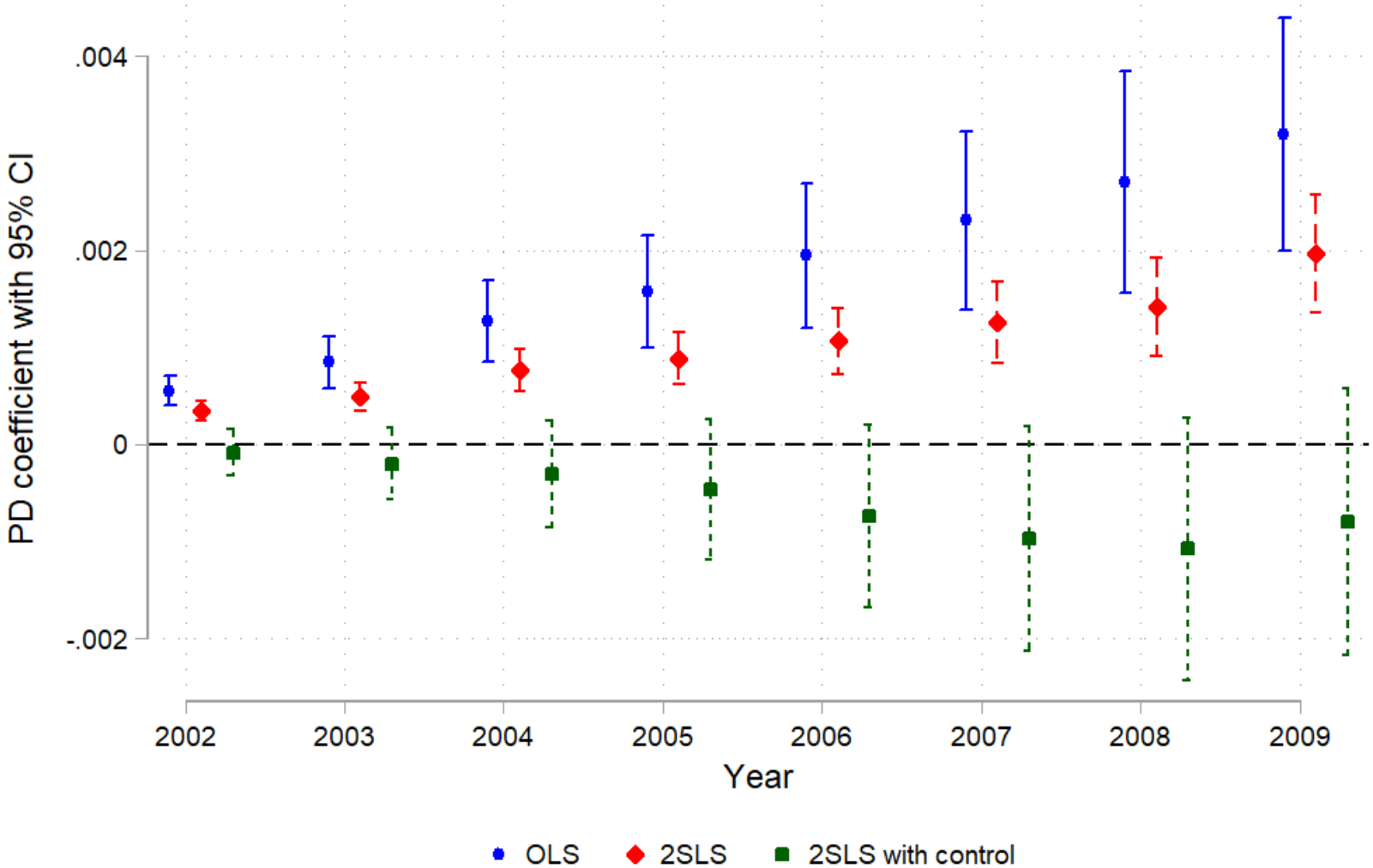
Number of Exporters/Population: PD coefficient by year



Source: SAIC registration database, Customs Data, and Population Census.

Revenue, TFP, and PD

Measurement:	Level			Z-score within Sector-Location-Year		
Dependent variable:	Ln(revenue)	Ln(TFP)	Ln(exporting revenue)	Ln(revenue)	Ln(TFP)	Ln(exporting revenue)
	(1)	(2)	(3)	(4)	(5)	(6)
PD*Time	0.507**	2.431***	0.675*	0.249***	0.207***	0.707***
	(0.211)	(0.691)	(0.388)	(0.058)	(0.064)	(0.218)
Time	0.127***	0.121***	0.158***	0.058***	0.033***	0.067***
	(0.006)	(0.020)	(0.019)	(0.002)	(0.002)	(0.011)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,172,933	2,172,933	75,455	2,172,933	2,172,933	75,455

Note: Ln(revenue) and Ln(TFP) are calculated based on the Inspection Data from 1998 to 2009. Ln(exporting revenue) is calculated based on the Customs Data from 2002 to 2009. Estimation uses that part of the variation in PD that can be explained by crop suitability. Standard errors clustered at the birth county level are reported.

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Revenue, TFP, and PD $\times$Network Size

Method:	OLS			IV		
Dependent variable:	Ln(revenue)	Ln(TFP)	Ln(exporting revenue)	Ln(revenue)	Ln(TFP)	Ln(exporting revenue)
	(1)	(2)	(3)	(4)	(5)	(6)
$PD \times \ln n_{t,t-1}$	1.781***	1.134***	0.642	4.775***	4.085***	3.811**
	(0.191)	(0.188)	(0.394)	(0.672)	(0.659)	(1.685)
$\ln n_{t,t-1}$	0.273***	0.170***	0.348***	0.101***	-0.020	0.110
	(0.007)	(0.007)	(0.023)	(0.028)	(0.025)	(0.093)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Kleibergon-Paap F	–	–	–	21.80	21.80	17.51
Observations	2,172,933	2,172,933	75,455	2,172,933	2,172,933	75,455

Note: Dependent variables are constructed as z-scores within sector-destination-year cells. Ln(revenue) and Ln(TFP) are calculated based on the Inspection Data from 1998 to 2009. Ln(exporting revenue) is calculated based on the Customs Data from 2002 to 2009. Standard errors clustered at the birth county level are reported.

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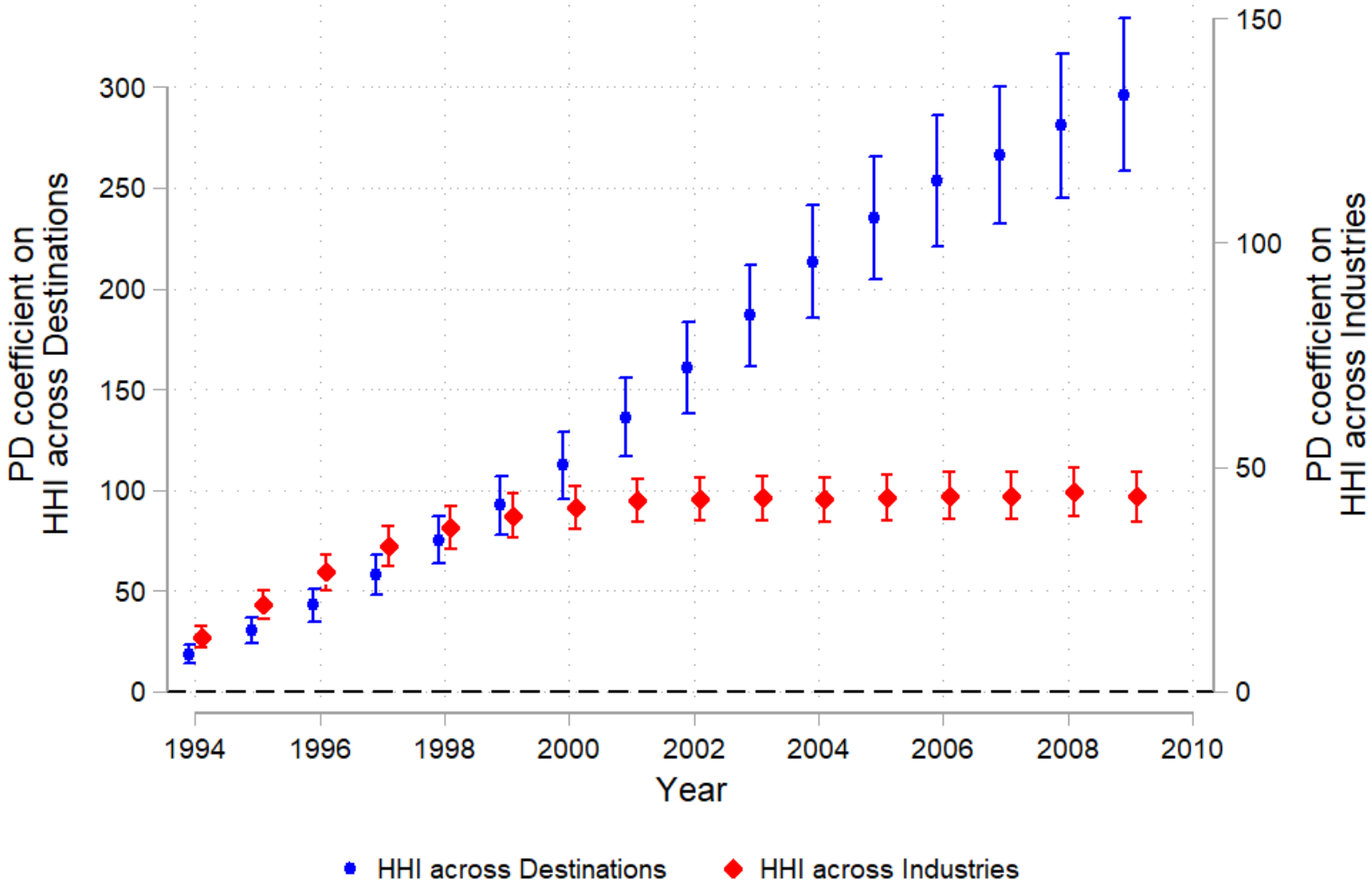
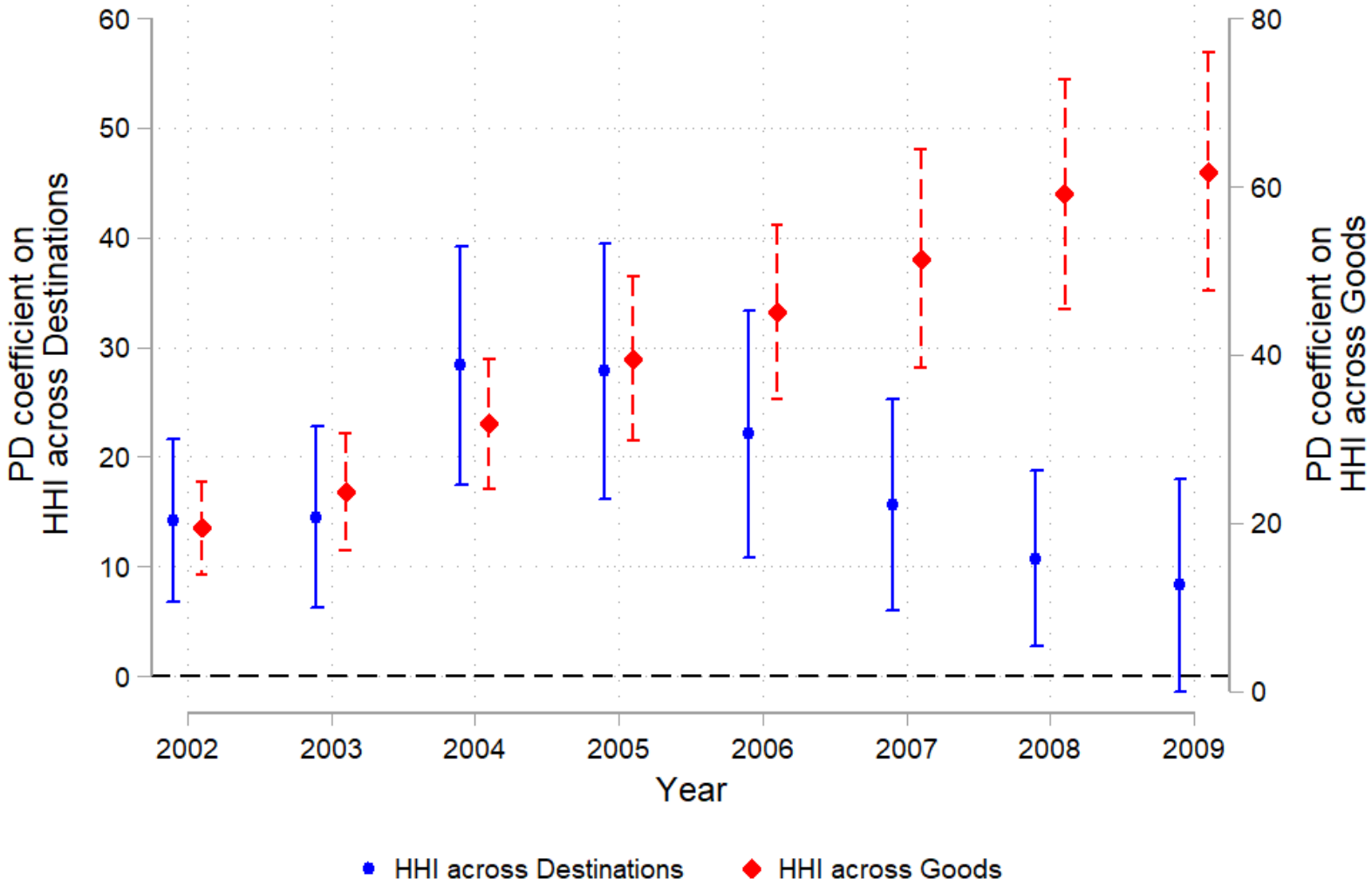
HHI of Domestic Firms and Population Density



Source: SAIC registration database.

HHI of Exporters and Population Density



Source: SAIC registration database and Customs Data.

Domestic firms, Pure exporters and Mixed firms: Based on Census Data

Year	2004		2008	
Type:	number	ln revenue	number	ln revenue
Pure domestic production firm	314,794	0.71	572,107	1.11
Pure exporter	805	1.97	2,621	1.85
Mixed firm	5,697	2.70	13,017	2.63

Source: Firm Census Data (2004,2008) and Customs Data.

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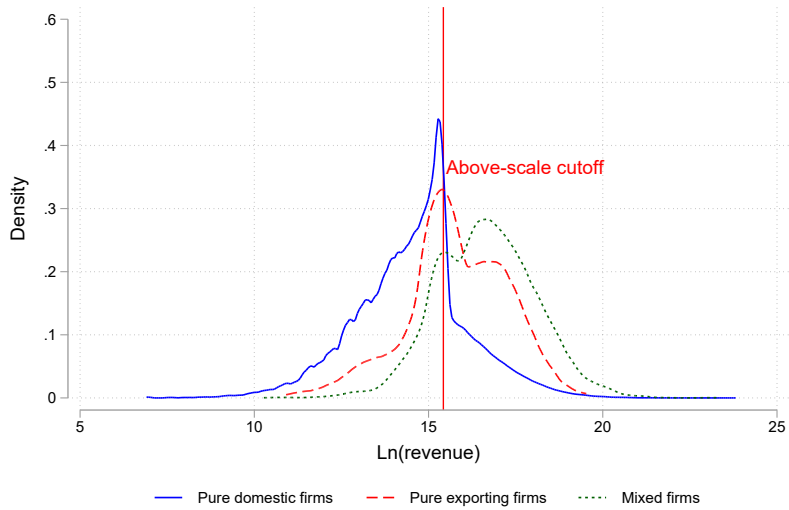
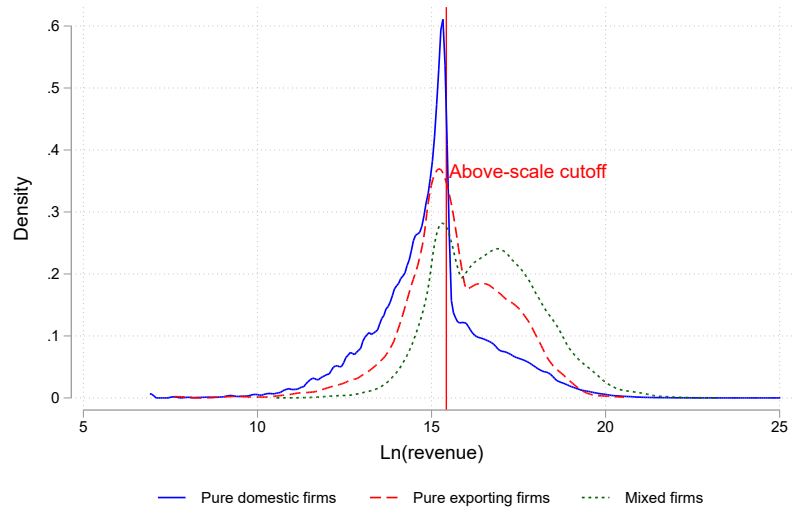
Revenue of Domestic firms, Pure exporters and Mixed firms: Based on Census Data



(a) Census 2004



(b) Census 2008

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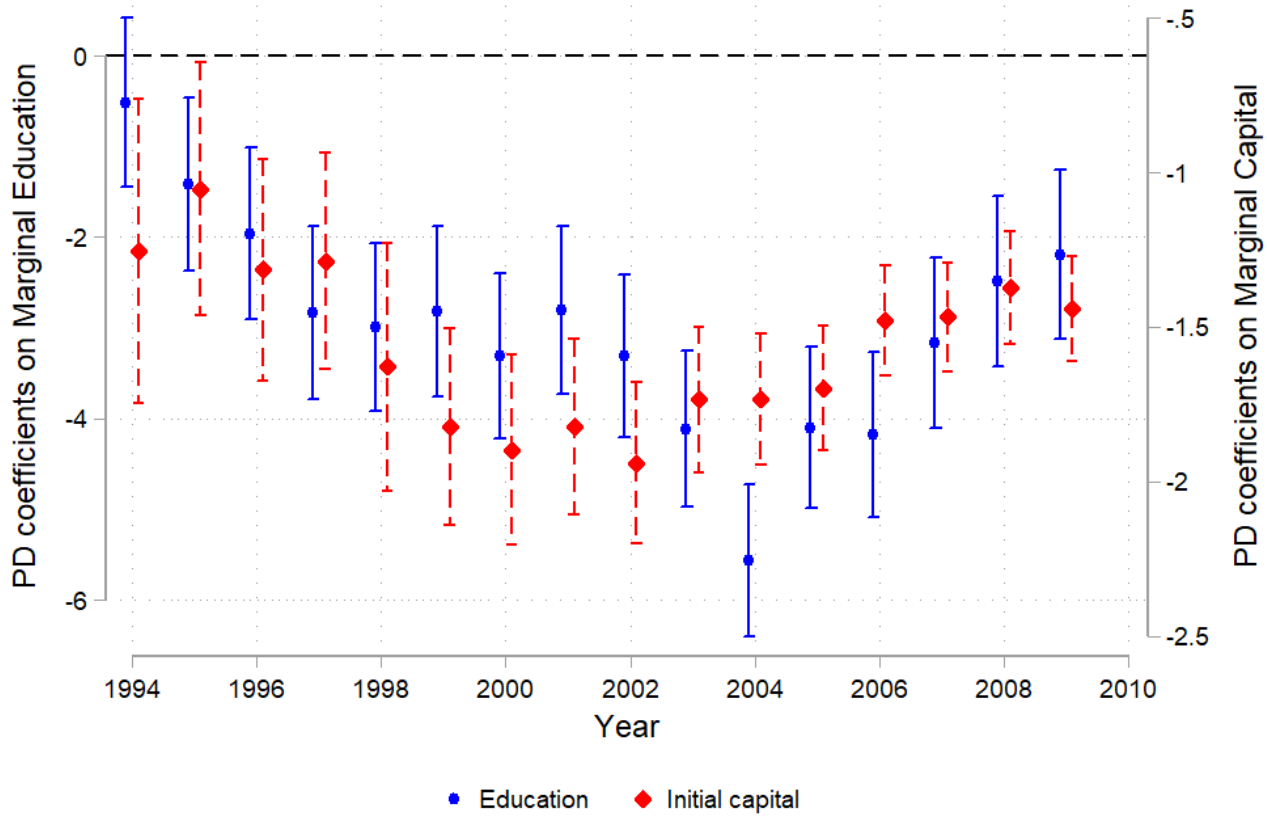
Marginal Education, Marginal Capital, and Population Density



Source: SAIC registration database and Population Census.

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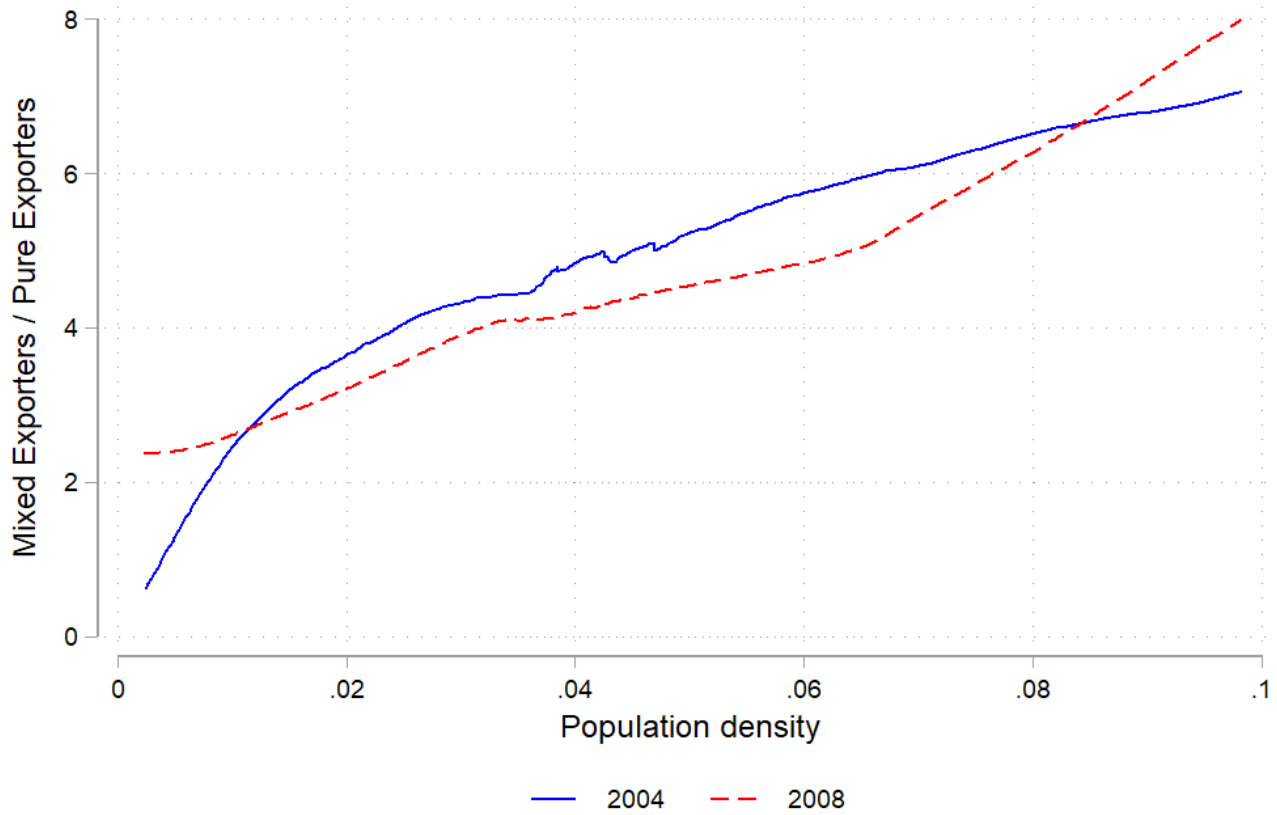
Mixed Exporters / Pure Exporters



Source: Firm Census Data (2004,2008) and Customs Data.

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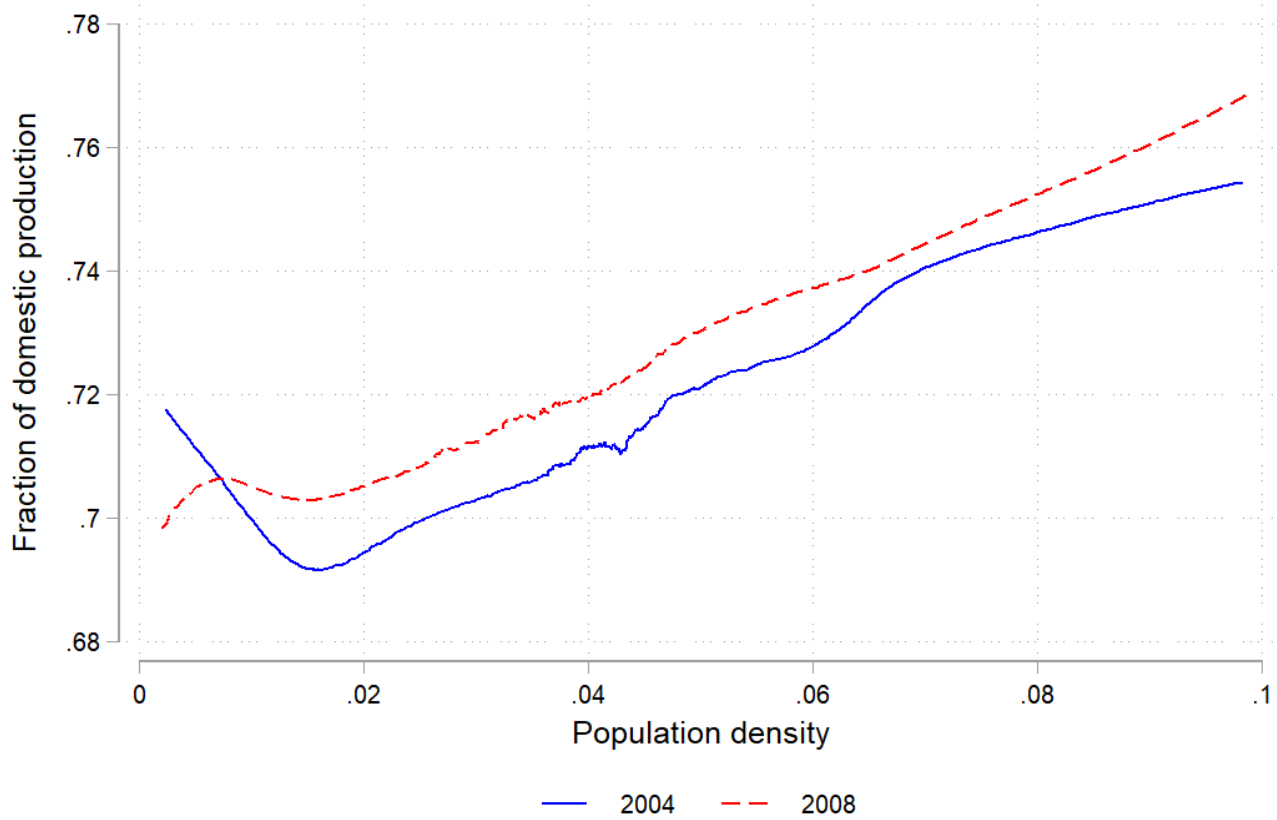
Share of Domestic Production Among Mixed Exporters



Source: Firm Census Data (2004,2008) and Customs Data.

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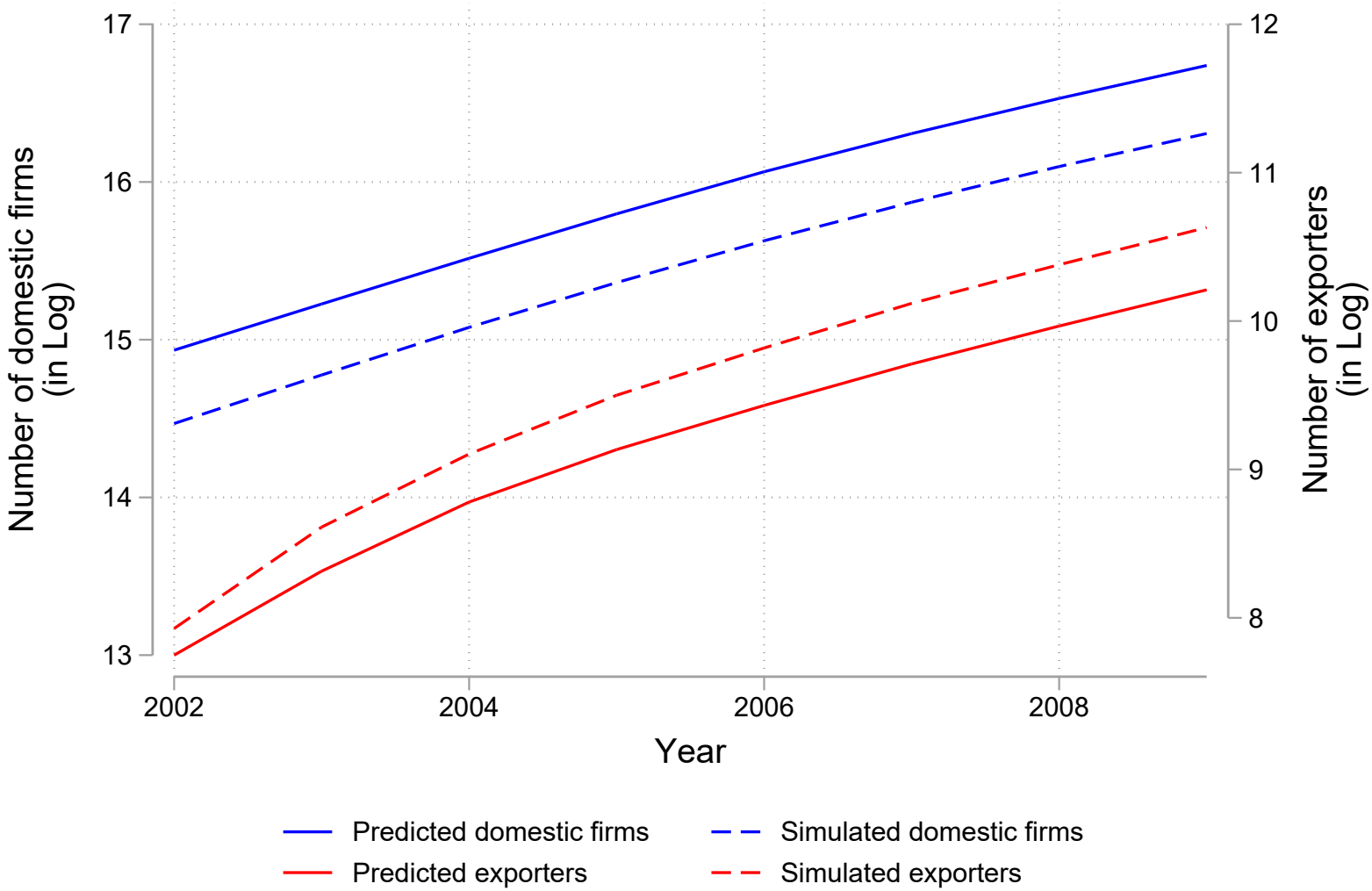
Counter-factual Analysis: Reduction in Domestic Network Strength



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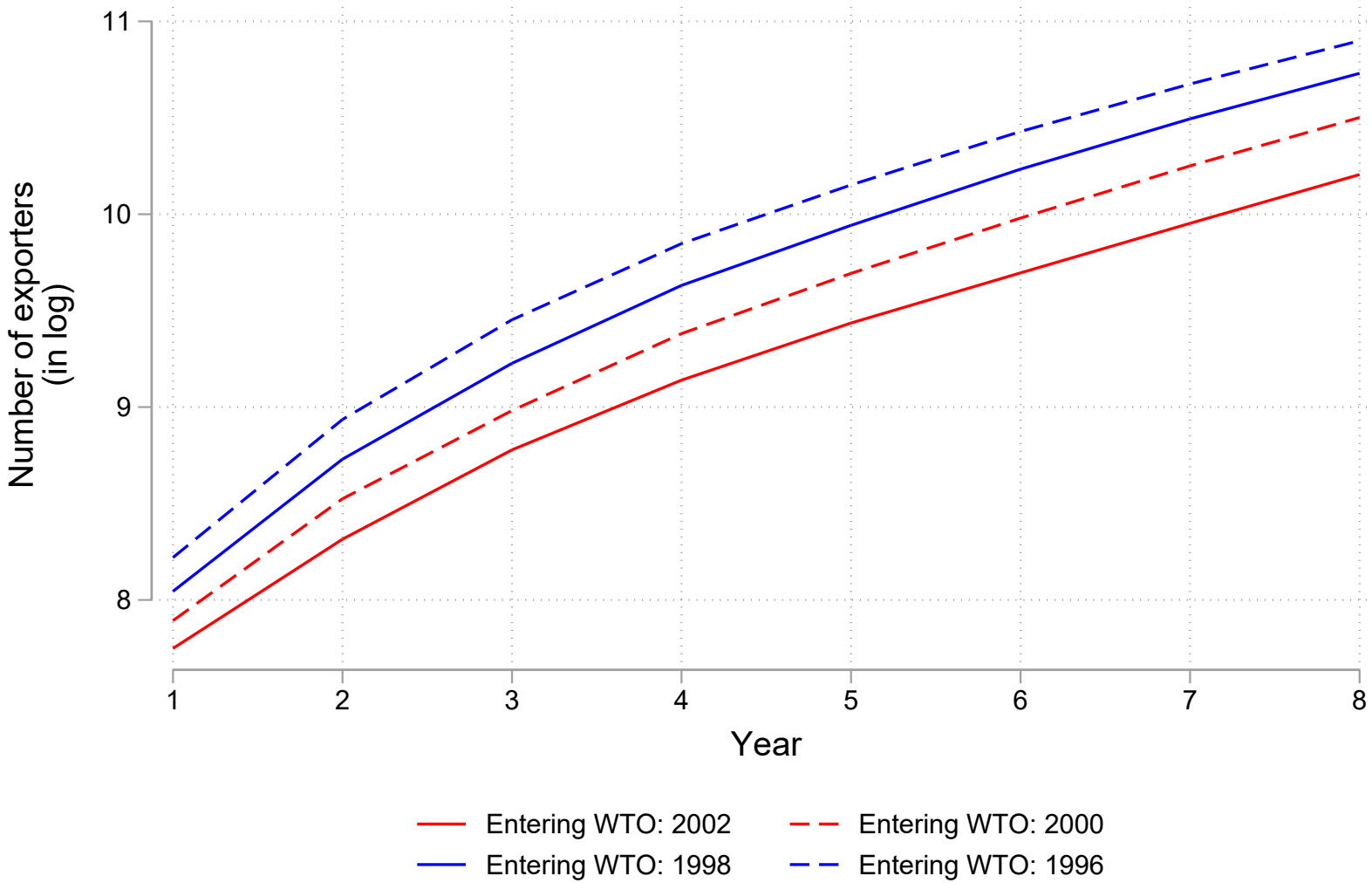
Counter-factual Analysis: Entering WTO Earlier



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Trust and Population Density

Respondent's location:	county		city	
Dependent variable:	trust in neighbors	trust in strangers	trust in neighbors	trust in strangers
	(1)	(2)	(3)	(4)
Population density	5.547***	-1.251	-0.305	-0.006
	(2.037)	(2.798)	(0.541)	(0.551)
Mean of dependent variable	6.430	2.205	6.282	2.177
Observations	18,995	18,995	6,499	6,499

Note: Trust in neighbors and strangers are measured as 0-10 from the adult individual module of the China Family Panel Study (2012). Family income and education are controlled. Standard errors clustered at the birth county level are reported.

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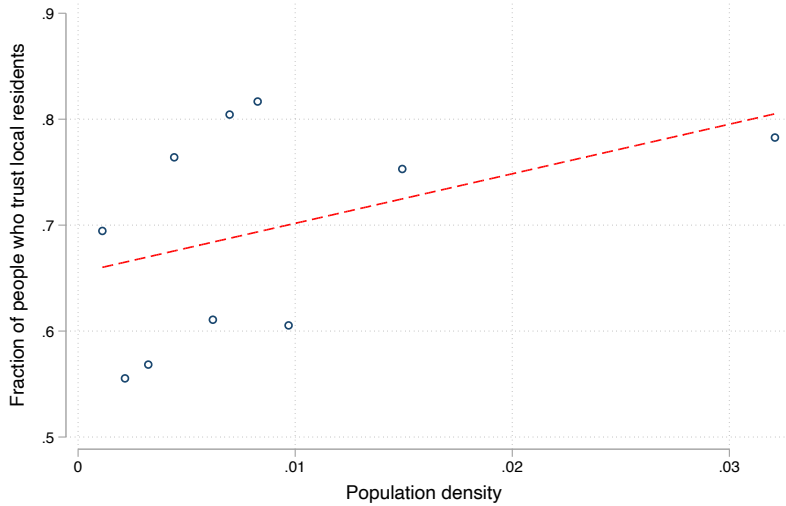
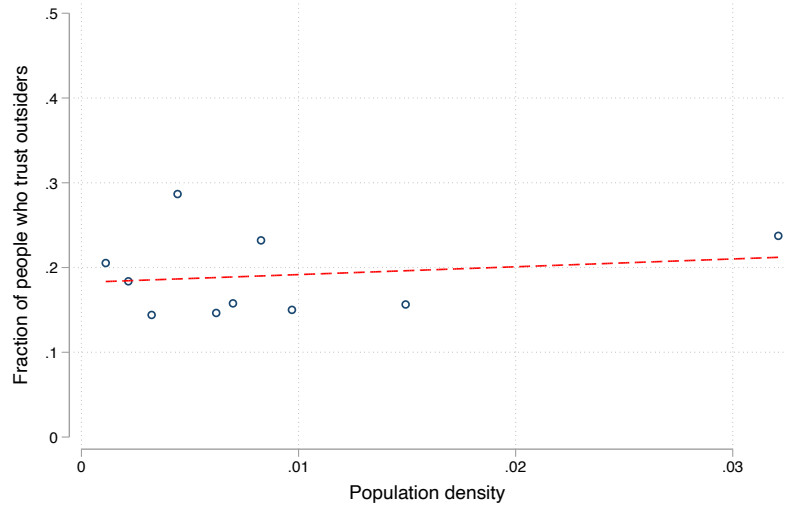
Trust and Population Density: Cross-Country Comparison



(a) Trust in Neighbors



(b) Trust in Strangers

Source: World Values Survey and World Development Index.

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Homophily and Population Density, Domestic Firms

Network:	listed individual			shareholder		
Dependent variable:	fraction of listed individuals from the same birth place	whether firm has links in the prefecture	whether linked firms are linked to a firm from the same birth county	fraction of shareholders from the same birth place	whether firm has links in the prefecture	whether linked firms are linked to a firm from the same birth county
	(1)	(2)	(3)	(4)	(5)	(6)
Population density	1.630***	0.332***	1.644***	1.711***	0.293***	1.759***
	(0.389)	(0.107)	(0.480)	(0.389)	(0.094)	(0.503)
Mean of dependent variable	0.488	0.268	0.499	0.476	0.248	0.436
Counter-factual mean	0.013		0.014	0.012		0.013
Observations	1,436,699	1,436,699	385,210	1,435,015	1,435,015	355,826

Source: SAIC registration database.

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Homophily and Population Density, Exporters

Network:	listed individual			shareholder		
Dependent variable:	fraction of listed individuals from the same birth place	whether firm has links in the prefecture	whether linked firms are linked to a firm from the same birth county	fraction of shareholders from the same birth place	whether firm has links in the prefecture	whether linked firms are linked to a firm from the same birth county
	(1)	(2)	(3)	(4)	(5)	(6)
Population density	2.879***	0.576***	1.931	3.233***	0.318*	4.663***
	(0.477)	(0.168)	(1.169)	(0.488)	(0.164)	(1.346)
Mean of dependent variable	0.585	0.0646	0.805	0.543	0.0470	0.715
Counter-factual mean	0.057	–	0.005	0.050	–	0.005
Observations	6,097	6,097	394	6,335	6,335	298

Source: SAIC registration database.

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Link Support and Population Density, Domestic Firms

Network:	listed individual		shareholder		combine	
Dependent variable:	fraction of links that are supported	number of supporting firms conditional on support	fraction of links that are supported	number of supporting firms conditional on support	fraction of links that are supported	number of supporting firms conditional on support
	(1)	(2)	(3)	(4)	(5)	(6)
Population density	1.640***	15.522***	1.186***	2.310	1.676***	15.537***
	(0.246)	(3.507)	(0.199)	(1.459)	(0.234)	(3.403)
Mean of dependent variable	0.288	1.797	0.174	1.382	0.298	1.811
Observations	1,611	1,291	1,581	1,035	1,620	1,346

Source: SAIC registration database.

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