ECONOMIC DEVELOPMENT & INSTITUTIONS

EDI WORKING PAPER SERIES WP/2022

HOMETOWN NETWORKS, PRIVATE ENTREPRENEURSHIP AND EXPORTING IN CHINA

Ruochen Dai

Central University of Finance and Economics

Dilip Mookherjee

Boston University

Kaivan Munshi

Yale University

Xiaobo Zhang

Peking University

September 2021

Oxford Policy Management · UKaid from the British people · Université de Namur · Paris School of Economics École d'Économie de Paris · ADE Analysis for Economic Decisions

Abstract

We document the following dissimilarity between patterns of selection into entrepreneurship and into exporting among Chinese entrepreneurs. Birth counties with higher population density (PD) exhibited higher levels and growth of entrepreneurship, but a lower fraction of active entrepreneurs were engaged in direct exports. This is robust to inclusion of controls for education and occupational patterns, and checks for possible measurement error in PD or reverse causality. Hence it is unlikely that PD is a proxy for unobserved ability, wealth or other attributes stimulating entrepreneurship. We develop a theoretical model explaining the observed patterns on the basis of stronger birth county-network-based spillovers among domestic producers than among exporters, and present evidence corroborating this explanation. This explanation suggests that while industrial development maybe stimulated by informal community networks, it can also generate a misallocation whereby the increased profitability of low value (production for the home market) activities discourages choice of higher value (exporting) activities.

Keywords. Firms. Entrepreneurship. Community networks. Exports. Misallocation. China.
JEL. J12. J16. D31. I3.

Research support from the Economic Development and Institutions (EDI) RA4 program is gratefully acknowledged.We are responsible for any errors that may remain.

Ruochen Daiy, Central University of Finance and Economics r.dai@cufe.edu.cn
Dilip Mookherjee, Boston University dilipm@bu.edu
Kaivan Munshi, Yale University kaivan.munshi@yale.edu
Xiaobo Zhang, Peking University x.zhang@nsd.pku.edu.cn

About Economic Development & Institutions

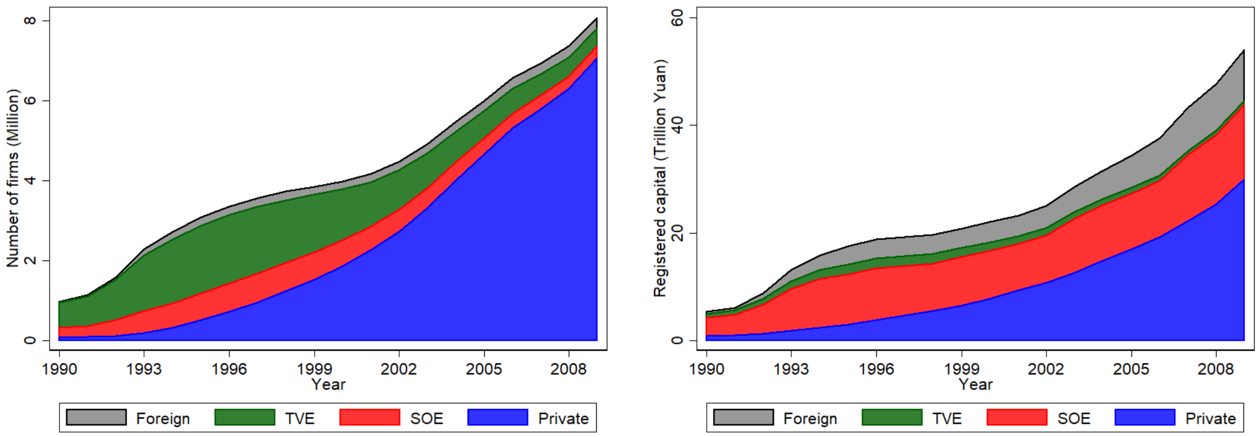
Institutions matter for growth and inclusive development. But despite increasing awareness of the importance of institutions on economic outcomes, there is little evidence on how positive institutional change can be achieved. The Economic Development and Institutions – EDI – research programme aims to fill this knowledge gap by working with some of the finest economic thinkers and social scientists across the globe.

The programme was launched in 2015 and will run until March 2022. It is made up of four parallel research activities: path-finding papers, institutional diagnostic, coordinated randomised control trials, and case studies. The programme is funded with UK aid from the UK government. For more information see http://edi.opml.co.uk.

---

1 Introduction

Since the early 1990s, China has experienced a sharp rise in private entrepreneurship. Figure 1 using Chinese firm registration data shows that starting from a small base, privately owned firms constituted more than 90% of all firms and approximately 60% of registered capital in 2009. Since 2001 when China joined the WTO, these firms have also played an important role in export growth. Figure 2 based on Chinese customs data shows that in 2009 firms owned by domestic private entrepreneurs comprised roughly 50% of all firms engaged in direct exporting and 30% of export revenues, compared to less than 20% in 2000.[1]



(a) Number of domestic firms

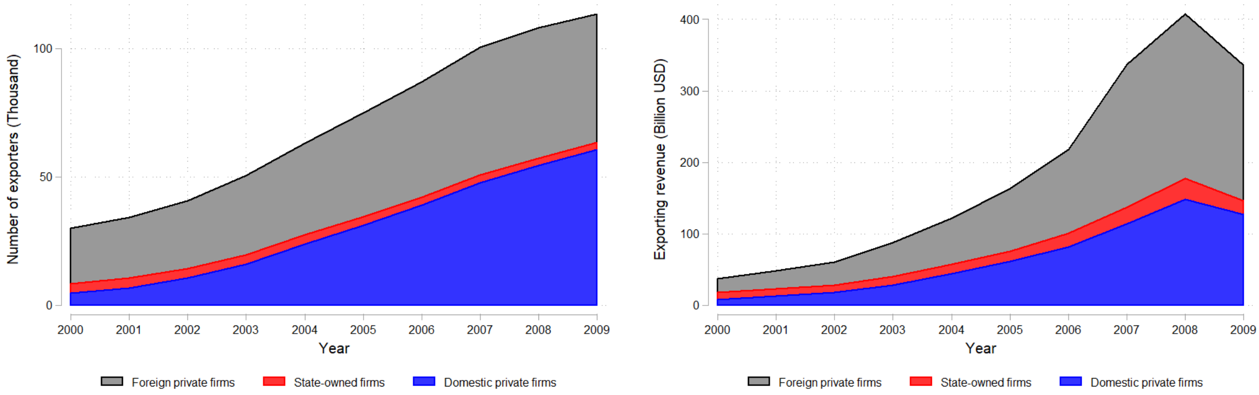
(b) Registered capital

Figure 1. Number of Domestic Firms and Their Registered Capital, by Ownership

Source: Authors' calculations using Business Registry Database.

Equally remarkable is the fact that a large fraction (approximately 60%) of private entrepreneurs originated in rural areas (i.e, were born in counties classified as rural), and accounted for a similar proportion of exports as shown in Figure 3. As shown in a number of papers in the literature (e.g., Peng (2004), Fisman et al (2018), Dai et al (2020)), a common birthplace or hometown constitutes an important source of social identity and connections in China, particularly in rural areas. The China Family Values Survey data indicates rural communities with higher levels of population density exhibited significantly greater levels of social interconnectedness and localized trust, unlike city born individuals (Dai et al (2020)). Figure 4 shows that among rural-born entrepreneurs, those from higher

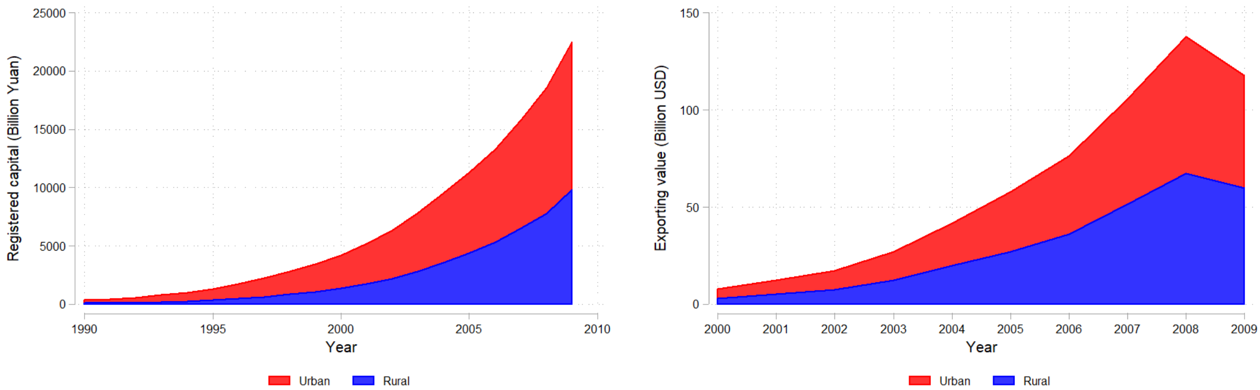
[1] Direct exporters are firms that export directly to foreign customers, in contrast to indirect exporters who sell export goods to Chinese owned trading firms, who in turn ship them overseas. We discuss this distinction further below.



(a) Number of direct production exporters (b) Direct production exporting revenue

Figure 2. Number of Direct Production Exporters and Their Exporting Revenue, by Ownership
Source: Authors' calculations using Chinese Customs Database and Business Registry Database.

population density hometowns exhibited a higher proportion chose to become private entrepreneurs. Moreover, this tendency became stronger in later years, resulting in growing divergence between high and low population density origins — suggesting that community networks may have played an important role in fueling the growth of entry into private entrepreneurship. Given the lack of well developed and efficient markets for credit, technology or legal institutions for enforcing private contracts, it is plausible that norms of informal cooperation and long term social relationships in hometown networks aided the growth of private enterprise.



(a) Registered capital (b) Direct exporting revenue

Figure 3. Registered Capital and Direct Exporting Revenue, by Rural and Urban Entrepreneur
Source: Authors' calculations using Chinese Customs Database and Business Registry Database.

Quantitative evidence for such a hypothesis faces a number of challenges. The fact that hometown

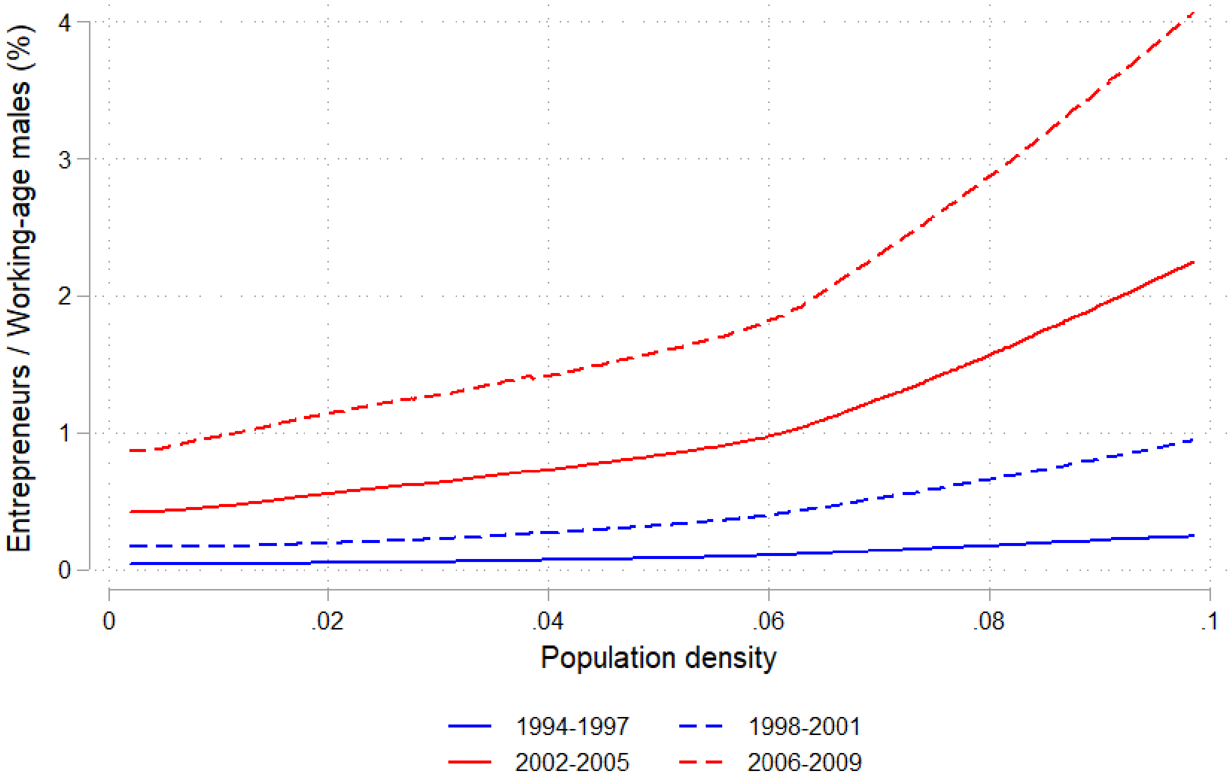


Figure 4. Entrepreneurial Propensity

Note: This figure reports LOWESS estimation of entrepreneurial propensity by periods on population density. Entrepreneurial propensity at the birth county-year level is measured as ratio of the number of survival firms over the population of males aged between 25 and 55 from 1994-2009.

population density is correlated with both norms of cooperation and with growth of entrepreneurship obviously does not imply a causal role of community networks. Population density is likely to be positively correlated also with many other attributes that stimulate entrepreneurship, such as wealth, education, locational advantages, superior governance or infrastructure. In Section 2 we show that the growing positive correlation of entrepreneurship with hometown population density survives even after controlling for many of these attributes. There may also be concerns of reverse causality, as higher levels of entrepreneurship might induce higher levels of migration or fertility, or upward biased errors in measuring population density. These concerns are mitigated by using the 1982 Census measure of population density, which would be unaffected by migration or fertility changes induced by the growth of private entrepreneurship after the 1990s or the One Child Policy started in the late 1970s. To further minimize reverse causality concerns, we show the results are robust if we replace the actual 1982 density by its value predicted by geographic determinants of historic settlement and migration patterns, such as indices of crop suitability of the local soil.

However, this still leaves open the possibility of bias arising from unobserved hometown attributes conducive to entrepreneurship that could be positively correlated with population density. To gauge this possibility, we examine selection of active entrepreneurs into exporting and how this varied across hometown population density. Following the influential work of Melitz (2003), the trade literature has provided compelling arguments and evidence that higher productivity firms are more likely to export. Hence if unobserved determinants of productivity were positively correlated with population density, we would expect to see greater selection into exports among entrepreneurs from higher density hometowns. However, Figure 5 shows the actual pattern of selection into exporting was exactly the opposite: it was declining in population density within each time period.

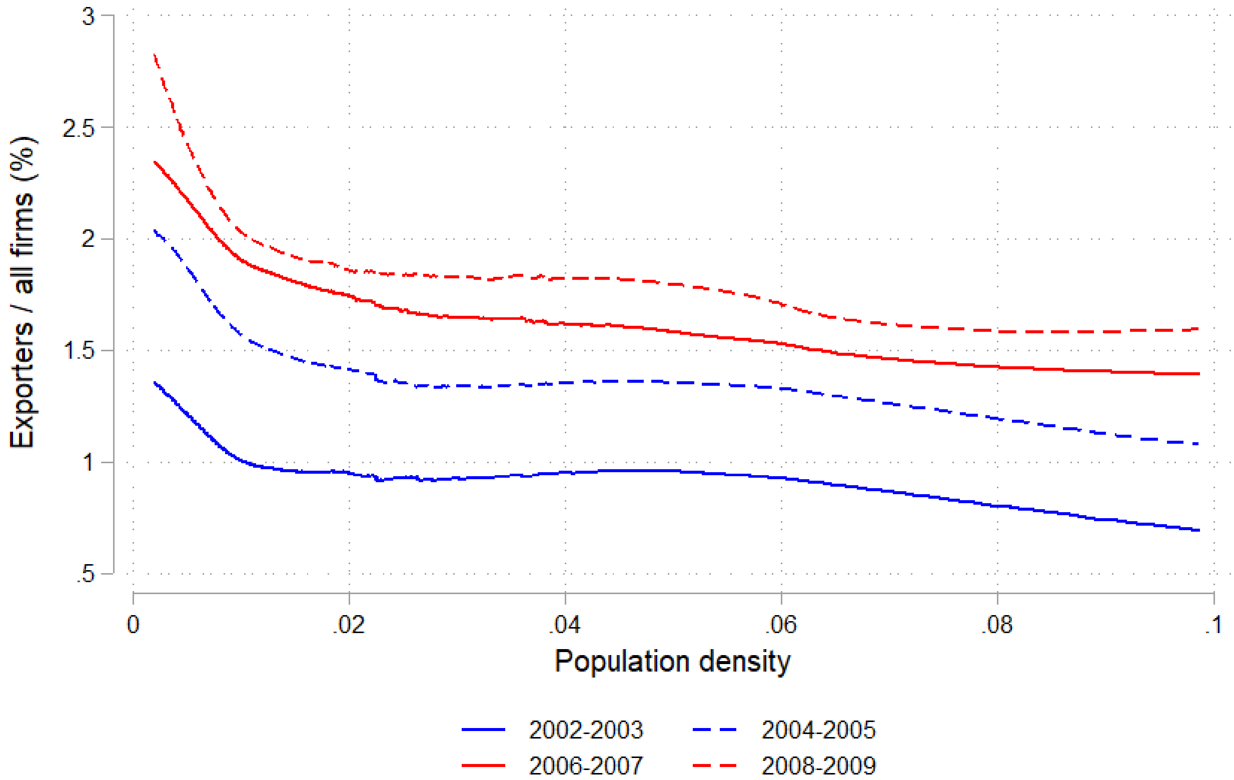


Figure 5. Export Selection, by periods

Note: This figure reports LOWESS estimation of export selection ratio by periods on population density. Export selection ratio is measured at birth county-year level as ratio of the number of firms with direct production export over the number of surviving firms in manufacturing industry.

We argue that this pattern can be explained by the role of hometown networks. Section 3 presents a model which explains how stronger community networks that stimulate entrepreneurship can at the same time discourage selection into exporting by high productivity firms. The main idea is the following. The simpler version of this explanation relies on irreversibility of entrepreneurial investments in products and marketing destination choices. The early rise of entrepreneurship during the 1990s occurred at a time when opportunities to export were limited and manufacturing firms were primarily serving home markets. High density networks achieved higher rates of growth of entry into entrepreneurship, resulting in larger size of the network that boosted productivity and profits via spillovers in products oriented to the domestic market. When entry into the WTO in 2001 increased export opportunities, entrepreneurs needed to select higher quality products and invest in developing new relationships with overseas customers to be able to take advantage of these possibilities. The large incumbent network serving the home market had limited experience in developing these products and relationships and thus did not help new exporters much. Hence entrepreneurs from high population hometowns had a weaker incentive to enter the export business relative to continuing to serve the home market, thereby raising the productivity threshold for exporting and lowering the fraction of entrepreneurs that were exporting. Over time a specialized network of exporters evolved, who helped each other resulting in spillovers across exporters from a common hometown. But as this network was considerably smaller and more specialized than the home network, the network effects continued to favor selection into the home market over exporting. Thus a large historical network served to partially 'lock in' the relevant community into the home market rather than exporting.

The model in Section 3 shows that the same outcome could result in a model without any irreversibility or adjustment costs, where incumbents can costlessly switch plants producing distinct products for different markets. Network effects arise both in the home and in the export sector, both rising in population density of the hometown, but with network effects (weakly) stronger on the home market. Entrepreneurs of varying innate abilities sort into different discrete choices at each date: specialize in serving the home market or export market respectively, serve both markets, or exit. Exporting requires products of higher quality that command a price premium but also necessitate higher costs of capital. All active entrepreneurs generate spillovers that raise productivity for those serving the home market, while only those exporting generate spillovers for other exporters. Our model departs from the standard trade models by incorporating diseconomies of scope between the home and export business for those entrepreneurs that decide to pursue both simultaneously (referred to as *mixed exporters* in contrast to *pure exporters* who specialize in exporting). These diseconomies can result from limited managerial attention (combined with frictions in delegation) owing to the larger span of control, in the spirit of Williamson (1967), Calvo and Wellisz (1978) or Lucas (1978). They are needed to explain the existence of firms that specialize in exporting, which comprised between 15-20% of all exporters during the period we study.[2]

We show in the model that firms sort into four different ability groups: the lowest ability group exit, the second category specializes on the home market, the third specializes in exporting, and the highest category become mixed exporters. Higher population density is associated with higher spillovers on the home and export markets respectively, with the home spillover rate weakly higher than the export spillover rate. A higher population density being associated with higher average innate ability lowers the entry threshold for active entrepreneurship (ie., into home specialization). This raises the entrepreneurial propensity, an effect that compounds over time to generate the pattern of growing divergence across hometowns of varying population density observed in Figure 4. Owing to the scope diseconomies of non-specialization, the effective choice faced by active entrepreneurs of intermediate ability is to specialize either in exporting or in home production. Hence a larger network of active entrepreneurs for higher density hometowns raises the profitability of serving the home market relative to the export market, i.e., resulting in a higher ability threshold for exporting. This tends to depress the fraction of active firms that export, an effect that offsets the higher innate average ability of the community as well as export spillover rate. So even in the absence of any inertia arising from adjustment costs, a larger home market spillover rate creates a disincentive to select into exports.

The model highlights a novel form of misallocation associated with community networks, manifested by insufficient incentive of active entrepreneurs to choose to export. In the equilibrium, aggregate profits within the community would rise with a small export subsidy funded by lump-sum contributions.

Section 4 provides evidence consistent with the model. We test predictions concerning comparisons of firm size (measured by revenues based on data on firm inspections for home producers for 1998-2008 and customs for exporters for 2002-08) across different types of firms, and reduced form regressions of revenues on population density, year and their interaction. Consistent with the model's predictions, firm revenues were highest for mixed exporters, followed by pure exporters, with home producers achieving the lowest revenues on average. Export revenues grew more slowly over time compared with domestic revenues for higher density networks (explained by weaker growth in the export network and weaker

[2] In their absence a firm that finds it profitable to export will also find it profitable to serve the home market.

export spillover rates in the model). We check this result is robust to inclusion of firm fixed effects and using historic crop suitability as an instrument for population density.

Section 5 presents additional evidence consistent with the presence of network effects that were not incorporated in the model for the sake of simplicity —- such as a pattern of increasing spatial and sectoral concentration for home producers from higher density hometowns that became more pronounced in later years. A similar pattern also appears for exporters with regard to product concentration, though not for spatial concentration, again in line with the hypothesis of weaker spillover effects in export networks.

Finally, Section 6 concludes the paper.

2 Data and Initial Regression Results

We use the Business Registry Data from the State Administration of Industry and Commerce (SAIC) for details of registered firms in each year from 1990 until 2009. The data for each firm lists key personnel and shareholders. The firm's legal representative is treated as the principal 'entrepreneur' associated with the enterprise. The birth county of the entrepreneur is obtained from the listed citizenship ID number. Additional information about personal characteristics of the principal entrepreneur such as age and education are also available. To establish the veracity of this data and allay concerns for existence of 'bogus' registered firms, we cross-check it with the corresponding number of registered firms from the Firm Censuses of 1995, 2004 and 2008. The close match between the two data sources is indicated in Figure 6 which shows the proportion of active entrepreneurs from the two different sources for the Firm Census years, when plotted against 1982 Census measure of population density of the birth county.

We identify as exporters those firms in manufacturing industries that directly exported their products to overseas customers, using Customs data for 2001-09. Data on export revenues is available for such firms, irrespective of their size. We thereby exclude indirect exporters, who sell export goods via trading firms, from the definition of an exporting firm. The reason is that indirect exports tend to be sold mainly to non-OECD countries, consisting of low quality goods commanding a lower sale price controlling for type of good (under the HS 6 digit classification) and year dummies, as shown in the regression in Table A1 in the Appendix. This regression includes direct exporters and trading firms (defined as firms in wholesale and retail industry with positive export revenues). It shows that the unit price of the good and likelihood of exporting to an OECD country were significantly less likely for

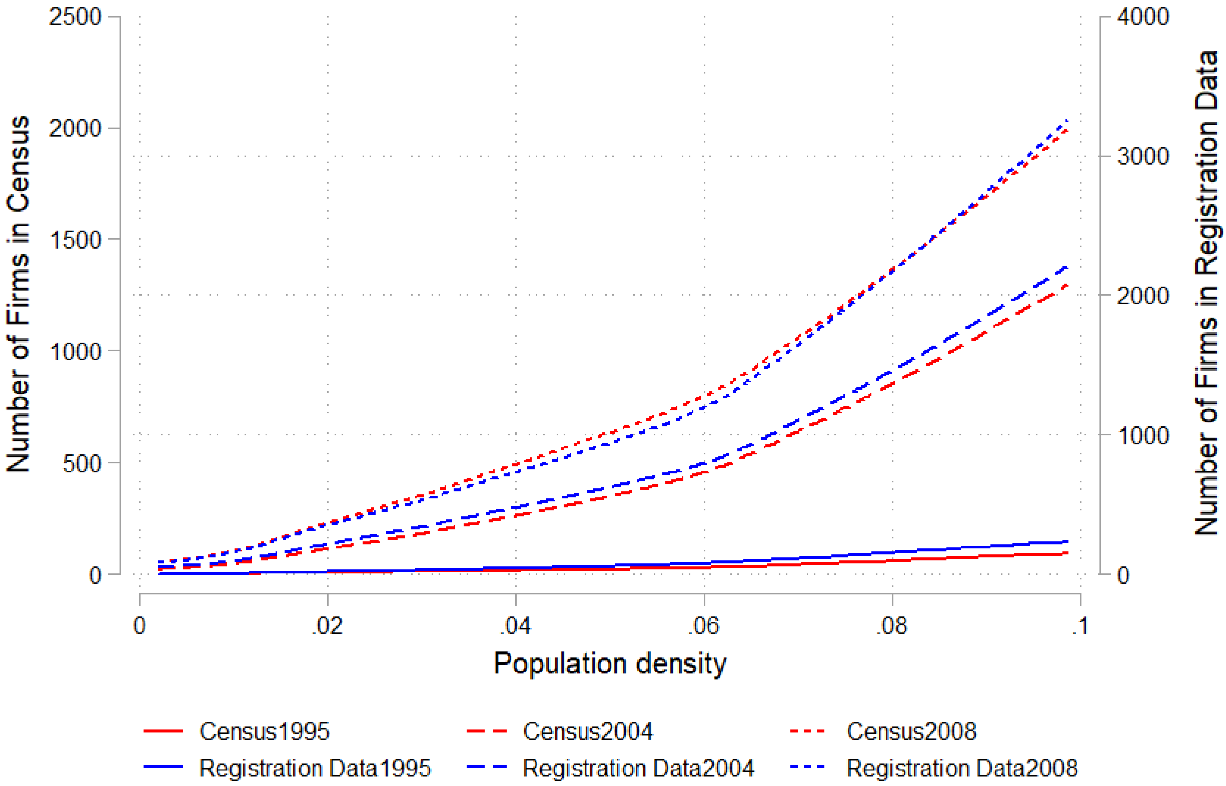


Figure 6. Number of Firms in Firm Census and Registration Data

trading firms. Hence indirect exports are similar to goods produced for the domestic market in terms of quality, price realization and destination. Our focus is in contrast on selection of firms into the high value export sector.

Figure A1 in the Appendix additionally provides the aggregate breakdown of export revenues between production and processing exports for different years, by type of firm ownership. We see that production exports constituted the bulk of export revenue for domestically owned private firms. Within production exports, Figure A2 in the Appendix provides the breakdown by direct and indirect export revenues for both above and below scale firms, using the Above-Scale Industrial Enterprise (ASIE) data in conjunction with the Customs data.[3] We see that above scale firms constitute the bulk of indirect

[3]Data for direct export revenues for both above and below scale firms is available from the Customs data. Indirect export revenue for above scale firms is calculated as the difference between total export revenue from the ASIE database and direct export revenue from the Customs data. For below scale firms aggregate indirect export revenues is obtained by subtracting direct export revenue of all production firms and indirect export revenues of above scale firms from the total export revenues of trading firms.

exports; hence the lack of indirect export revenues at the firm level for below scale firms is unlikely to affect the main result of Appendix Table A1 which excluded below scale firms.

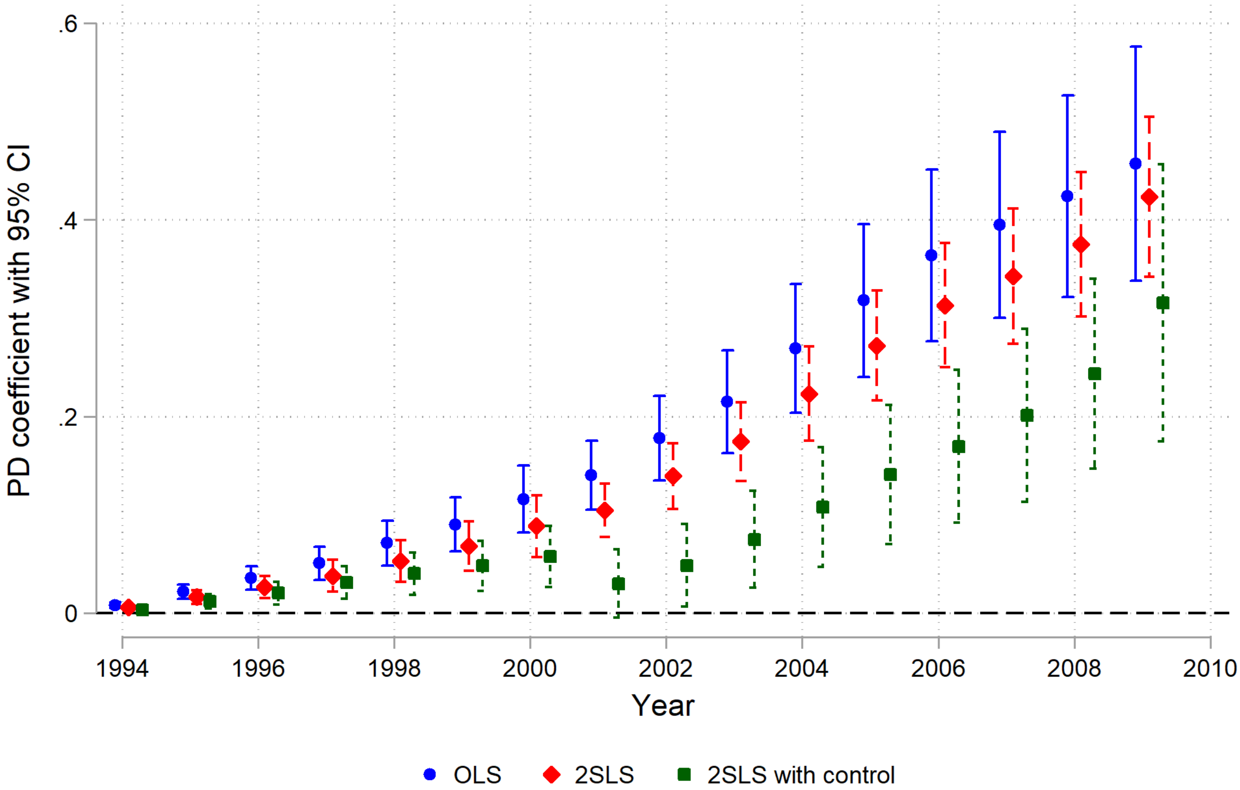


Figure 7. Propensity of Becoming Entrepreneurs by Period and Population Density (PD) Coefficient by Year

Note: propensity to become an entrepreneur at birth county-year level is measured as ratio of the number of survival firms over the population of males aged between 25 and 55 from 1994-2009. The figure reports the PD coefficients of regressions at birth county level in each year with different specifications. OLS specification regresses the propensity on PD directly by year. 2SLS specification uses crop suitability as an instrument variable for PD. 2SLS with control specification adds control variables as the average of dummy variables for each education, industry and occupation categories of each birth county. Entrepreneurs' information is from the Business Registry Database. Population density is from the 1982 Census. Population and control variables in 1994-1999 are from the 1990 Census and those in 2000-2009 are from the 2000 Census. Crop suitability is measured at the county level based on 1990 China GIS map, following Galor and Ozak (2016). Standard errors are clustered at birth county level.

Next we examine the robustness of the patterns shown in Figures 4 and 5 to inclusion of controls and 'instruments' for population density (PD). Figure 7 reports the coefficients of birth county PD in regressions of the entrepreneurial propensity (the ratio of entrepreneurs of surviving firms to male population aged between 25 and 55) for different years from 1994 to 2009 corresponding to different specifications. The OLS specification regresses the propensity on PD directly by year. The 2SLS specification uses crop suitability of the birth county (based in the 1990 China GIS map, following Galor and Ozak (2016)) as an instrument for PD. As there may be concerns with the validity of the exclusion restriction, this is a predictor of PD rather than a valid instrument which helps address measurement error or reverse causality concerns. The 2SLS with control specification adds as controls the relative frequencies of different education, occupation and industry categories in the birth county. The OLS and 2SLS coefficient estimates are quite close, while adding controls attenuates their magnitudes. However, in all three specifications the coefficient is positive, statistically significant and increasing in later years. Hence the pattern shown in Figure 4 for entrepreneurial propensity is robust.

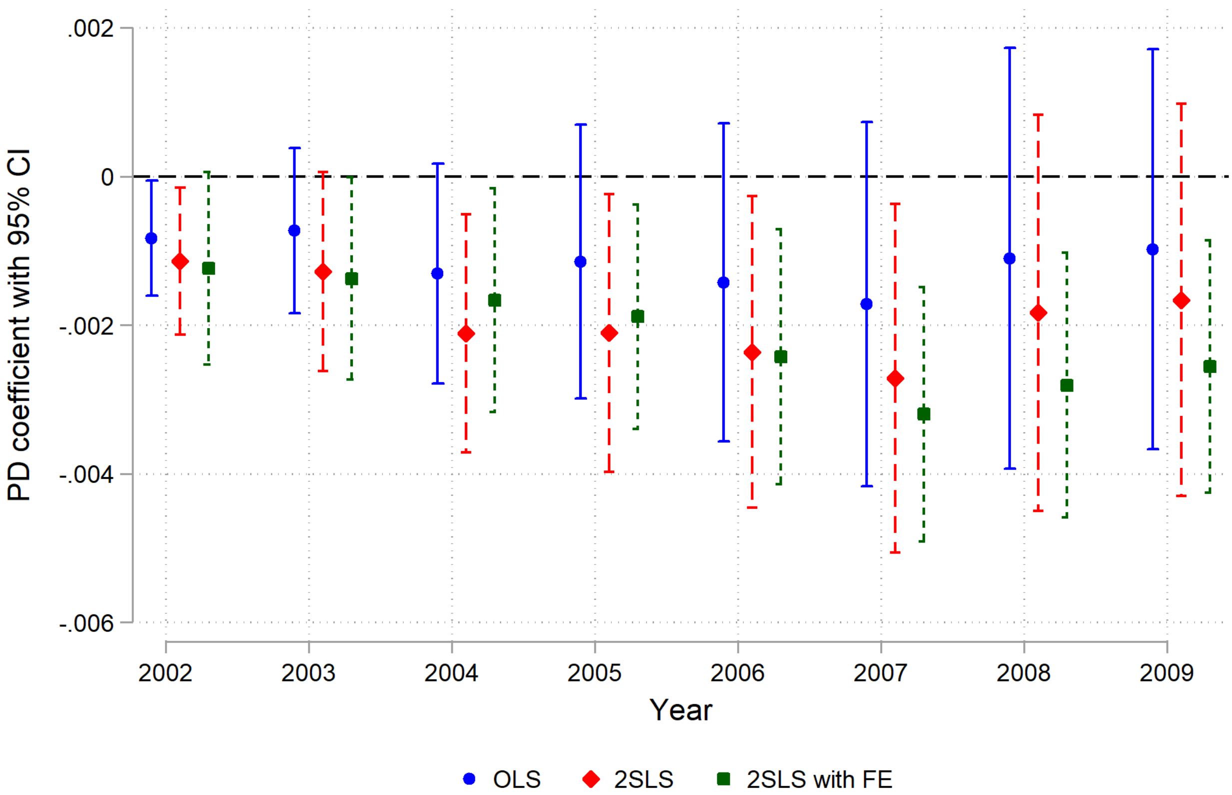


Figure 8. Selection into Exports: PD Coefficient by Year

Note: The figure reports the PD coefficients of regressions at firm level in each year with different specifications. The dependent variable is a dummy for whether the firm is a direct production exporter in the given year The OLS specification regresses this dummy on PD directly by year. The 2SLS specification uses crop suitability as an instrument for PD. 2SLS with FE adds the firm's location (at prefecture level) and industry (at 2-digit level) fixed effects. Entrepreneurs' and exporters' information is from the Business Registry Database and the Chinese Customs Database. Population density is from the 1982 Census. Standard errors are clustered at birth county level.

Figure 8 reports results of a similar robustness exercise for the pattern exhibited in Figure 5 for variation of selection into exporting with population density of the birth county for different years. Here the regressions are at the firm level, whether it is a direct exporter or not. The 2SLS specification with FE includes dummies for the firm's location (at the prefecture level) and 2 digit industry. The use of instrument and inclusion of controls strengthens the significance of a negative coefficient of export selection on PD, in stark contrast to the positive coefficient of entrepreneurial propensity on PD. In the next section we present a model which provides an explanation of these findings based on network effects for home production and exporting respectively.

3 Model

3.1 Assumptions

We consider a specific hometown network, abstracting from firms originating in other hometowns. This implicitly assumes the absence of cross-network spillovers or general equilibrium effects through output or factor prices. The justification for this assumption is as follows. First, firms from any given origin county accounts for only 12% of firms and 18% of capital share at the destination (rural or urban) where they locate (within two-digit sectors) in the firm registration data. Moreover, regressions of post-1995 entry flows for each county into a given destination on the stock of entrants during 1990-94 from the same county and all other locations show a strong positive effect of the former and a negligible effect of the latter, indicating zero cross-network effects. The Chinese data shows sharp growth in number of firms during the period under consideration, which can be viewed as an early stage of industrialization where congestion effects have not yet come into play. Besides, we use the model to generate reduced form predictions for entry into different sectors, which are then tested in the empirical analysis after controlling for year dummies that absorb year-to-year changes in prices or other general equilibrium effects.

The underlying population of potential entrepreneurs vary in individual ability ω, which has a log-uniform distribution on the unit interval. The specific distribution facilitates explicit closed form solutions for the equilibrium; we expect the qualitative results will be the same for a broader class of distributions. There is a new cohort of unit mass that is born in each period (with ability drawn from the same log uniform distribution), so in period t there is a total stock of t potential entrepreneurs.

The baseline model also abstracts from dynamic adjustment costs or any form of irreversibility of destination choices. Section 3.5 considers a variant with such irreversibility and shows that it generates similar results. In the presence of such adjustment costs a large historical stock of incumbents in the home network can result in subsequent lock-in to the home market somewhat mechanically. The purpose of the model is to show how a misallocation in the form of an excessively large home network can result even in the absence of any adjustment costs. Hence the main source of interdependence of choices made by potential entrepreneurs will be atemporal, i.e., depend on choices made by the rest of the population at the same date. The dynamics will be generated entirely the growth in the stock of potential entrepreneurs on on otherwise atemporal equilibrium.

At date t, each potential entrepreneur of ability ω decides whether to enter, or stay out and receive a payoff of ω^{σ}, where $\sigma \in (0, 1)$. An entering agent can decide whether to produce for the home market or export market or both.Those that specialize in one of the two markets set up a single plant. Hence there are four essential choices faced by each entrepreneur: drop out, specialize on the home market, specialize in exporting, and serve both markets. Entrepreneurs that decide to produce both for the home and export markets set up separate plants for these different businesses. Besides deciding which markets to serve, each entrepreneur also decides on the scale of the respective plants. Choices are flexible across periods, owing to the lack of any dynamic adjustment costs or irreversibility as explained above. No assumption regarding foresight or patience is necessary as current decisions have no impact on future payoffs.

Active entrepreneurs form a network helping each other boosting mutual TFP or the size of market orders per entrepreneur. Within the network, there is a sub-network of exporters who help each other with their export business. Thus home production benefits from help from the entire network, while exporting benefits from the export sub-network. The rationale for this assumption is that the community norm requires all entrepreneurs to contribute to help others in the network whenever such help is requested. However, exporters benefit only from help from other exporters as the products and destinations they serve require special expertise not available to home producers.

Specifically, network spillovers are modeled as follows. Community help provided for home production at t is represented by a contribution $C_{ht} = \exp(\theta_h n_t)$ to TFP in home production, where n_t is the size of the whole network active at t, and θ_h represents the 'quality' of each network connection. This is closely related to the specification in many macro-trade-geography models that incorporate agglomeration spillovers (e.g., Ciccione-Hall (1996), Au-Henderson (2006), Hanlon and Miscio (2017)) where log TFP is assumed to rise linearly in local employment levels (which would rise with the number of firms in the local area). The main difference of our formulation is that these spillovers are restricted to firms (operating at the same destination) that originate in the same hometown.

Let n_{xt} denote the set of entrepreneurs that export at t, so $n_t - n_{xt}$ denotes the size of entrepreneurs specializing in home production. Community help for exports is analogously provided by contribution $C_{xt} = \exp(\theta_x n_{xt})$ to TFP of an export plant. We assume $\theta_h \geq \theta_x$, that the per capita contribution of an active network member to TFP in home production is not lower than to export production. θ_h, θ_x could both be rising in population density p or other measures of connectedness of the hometown. Note that since $n_t \geq n_{xt}$ and $\theta_h \geq \theta_x$, the community contribution to home production cannot ever fall below that to export production.

The ability ω of the specific entrepreneur can be interpreted as the quality of the product produced for the home market. Quality commands a higher premium on the export market. Revenues from home production and exports are as follows for an entrepreneur that specializes in either of these activities:

$$R_{ht} = (1 - \alpha)C_{ht}\omega^{1-\alpha}K_{ht}^{\alpha}, R_{xt} = (1 - \alpha)C_{xt}\omega^{\delta(1-\alpha)}K_{xt}^{\alpha} \tag{1}$$

where K_{ht}, K_{xt} respectively denote capital size of the home production and export plants, $\alpha \in (0, 1)$ and $\delta > 1$ is the quality export premium.

Note the diminishing returns feature of revenues with respect to scale in (1). This can be interpreted as a technological assumption in a perfectly competitive setup where the firm takes the product price as given. Alternatively it can correspond to local market power exercised by each firm which produces a differentiated good under constant returns to scale, in a monopolistic competition framework. In a Dixit-Stiglitz formulation where each firm faces a downward sloping CES demand curve, each firm ends up setting its price at a constant markup over its unit cost, resulting in a revenue function that exhibits constant elasticity with respect to scale or firm size.

The corresponding expenditures on a home plant and export plant are:

$$E_{ht} = rK_{ht}, E_{xt} = r(1 + I)K_{xt} \tag{2}$$

where r includes interest and material costs of equipment, and $I > 0$ is an incremental cost of export plant arising from need to vertically integrate production or conform to export standards.

Finally, we assume a 'loss of control' arising from diseconomies of scope or limited managerial time of the entrepreneur that produces for both home and export markets. The negative effects of increasing span of control play an important role in the literature on organizational economics dealing with limits to the size of firms (going back to Williamson (1967), Calvo and Wellisz (1978) and Lucas (1978)). The control loss has two sets of consequences. First, it reduces productivity by some proportion in each plant, denoted by $\pi_h, \pi_x \in (0,1)$ respectively. Second it limits the extent to which the entrepreneur can tap into the relevant network for help, thus limiting the scale of spillovers by $\lambda_h, \lambda_x \in (0,1)$ respectively. So that total revenues of such an entrepreneur are

$$R_{mt} = [(1-\alpha)\pi_h \exp(\lambda_h \theta_h n_{ht})\omega^{1-\alpha} K_{ht}^{\alpha} + (1-\alpha)\pi_x \exp(\lambda_x \theta_x n_{xt})\omega^{\delta(1-\alpha)} K_{xt}^{\alpha}] \tag{3}$$

The relative magnitude of these productivity and spillover losses between the home and export plant may depend on time allocation decisions made by the entrepreneur between the two businesses. The model could be extended to include this allocation decision (whereby it could vary with the entrepreneur's ability and relative returns from the two lines of business) but in the current version we abstract from this choice and take the losses to be fixed parameters. Scope diseconomies do not appear in standard trade and geography models. In the Chinese setting it is needed to explain the presence of firms that specialize in exporting: in the absence of such scope diseconomies, a firm that finds it profitable to export will also find it profitable to produce for the domestic market.

3.2 Equilibrium

A **Nash equilibrium** at t is a decision made by each potential entrepreneur at t between the four activities (inactivity, specialize in home or export production, or produce for both markets) which constitutes a best response to the resulting network aggregates (n_t: number of active entrepreneurs, n_{xt}: the number that export).

Given the facts pertaining to variation of sizes across firms selecting different destinations, we are interested in equilibria involving strategies of the following kind. In period t entrepreneurs of ability below ω_{ht}^* are inactive. Those between ω_{ht}^* and a higher threshold ω_{et}^* specialize in domestic production. The next higher range $(\omega_{et}^*, \omega_{mt}^*)$ correspond to specialization in exports, and finally those above ω_{mt}^* produce for both markets. If $\log \omega_{et}^*$ exceeds one, all active agents specialize in home production. Otherwise some active agents specialize in home, and others in exports. If ω_{mt}^* exceeds one, all active agents specialize, otherwise a positive fraction pursue both home production and exports.

In such a strategy configuration, community spillover expressions for pure home and exporters are $C_{ht} = t\theta_h(1-\log \omega_{ht}^*), C_{xt} = t\theta_x(1-\log \omega_{et}^*)$. Hence profits corresponding to the four destination choices (on the extensive margin) are as follows (upon incorporating optimal scales for each plant, i.e., on the intensive margin):

$$
\begin{aligned}
\Pi_0(\omega) &= \sigma \log \omega \\
\Pi_{ht}(\omega) &= \log \omega + t\theta_h(1 - \log \omega_{ht}^*) - \log \zeta \\
\Pi_{et}(\omega) &= \delta \log \omega + t\theta_x(1 - \log \omega_{et}^*) - \log \zeta - \gamma \\
\Pi_{mt}(\omega) &= [\log \omega + t\lambda_h\theta_h(1 - \log \omega_{ht}^*) - \log \zeta] + [\delta \log \omega + t\lambda_x\theta_x(1 - \log \omega_{et}^*) - \log \zeta - \gamma] - \beta
\end{aligned}
$$

where

$$
\log \zeta \equiv \frac{1}{1-\alpha}[\log r - \log \alpha - \log(1-\alpha)], \gamma \equiv \frac{\alpha}{1-\alpha}\log(1+I) > 0, \beta \equiv -[\log \pi_h + \delta \log \pi_x] > 0.
$$

These parameters can be interpreted as follows: $\log \zeta$ is the cost associated with a home plant, γ the incremental cost associated with an export plant, and β another increment representing the cost of managing two plants.

The following assumptions are imposed on the parameters. We explain below the role of each of these assumption in generating an 'interior' equilibrium featuring a positive fraction of agents who are inactive and those specializing in home production respectively. Letting T denote an upper bound for t:

$$T\theta_h < \log \zeta < 1 - \sigma \tag{A1}$$

$$\frac{\gamma}{\delta - 1} > \frac{\log \zeta}{1 - \sigma} \tag{A2}$$

$$T\theta_x < \delta - 1 \tag{A3}$$

$$\beta > \log \omega_e^* - \log \zeta + T\lambda_h\theta_h[1 - \frac{\log \zeta - T\theta_h}{1 - \sigma - T\theta_h}] \tag{A4}$$

where $\omega_e^* \equiv \max_{t=1,\ldots,T}\{\omega_{et}^*\}$ and ω_{et}^* is defined below.

Proposition 1 *Assume (A1)-(A4). Then at date t there is a Nash equilibrium with the following thresholds:*

$$
\begin{aligned}
\log \omega_{ht}^* &= \frac{\log \zeta - t\theta_h}{1 - \sigma - t\theta_h} \\
\log \omega_{et}^* &= \frac{\gamma + t\theta_h\{1 - \log \omega_{ht}^*\} - t\theta_x}{\delta - 1 - t\theta_x} \\
\log \omega_{mt}^* &= \beta + \log \zeta - t\lambda_h\theta_h(1 - \log \omega_{ht}^*) - t(1 - \lambda_x)\theta_x(1 - \log \omega_{et}^*), \quad \textit{provided} \quad \log \omega_{et}^* < 1.
\end{aligned}
$$

The reasoning is as follows. The expression for $\log \omega_{ht}^*$ is obtained from the condition $\Pi_0(\omega_{ht}^*) = \Pi_{ht}(\omega_{ht}^*)$, stating that an agent is indifferent between being inactive and specializing in home production. Condition (A1) states that the cost associated with a home plant is large enough to deter agents of exceptionally low ability from entering, yet not so large that it deters higher ability agents. It therefore ensures ω_{ht}^* lies in the interior of the range of abilities in the population. Agents with ability below ω_{ht}^* prefer being inactive to specializing in home production, and the opposite is true for those with higher ability.

(A1) also implies that $\log \omega_{ht}^*$ is decreasing in t and in θ_h. This ensures entry flows into entrepreneurship grow over time, and the marginal type that enters has progressively lower individual ability. The same is true at any date, for networks with higher network quality θ_h.

Next, condition (A2) can be interpreted as saying that the incremental investment cost for exports relative to the quality premium in sales revenue is large enough to ensure that specialization in home production dominates export specialization for type ω_{ht}^*, i.e., $\Pi_{ht}(\omega_{ht}^*) > \Pi_{et}(\omega_{ht}^*)$. The reason is that (A2) ensures that

$$\gamma > (\delta - 1)\frac{\log \zeta}{1-\sigma} \geq (\delta - 1)\log \omega_{ht}^*$$

Combining this with $C_{ht} \geq C_{xt}$ at every date t, we obtain

$$\Pi_{ht}(\omega_{ht}^*) \equiv \log \omega_{ht}^* + C_{ht} - \log \zeta > \delta \log \omega_{ht}^* + C_{xt} - \log \zeta - \gamma \equiv \Pi_{et}(\omega_{ht}^*).$$

It follows that for ability slightly above ω_{ht}^*, specialization in home production also dominates export specialization.

Condition (A3) says the quality export premium is large enough to ensure that as ability rises beyond ω_{ht}^*, payoffs associated with export specialization increase faster (at rate δ) than payoffs associated with home specialization. Hence at some threshold $\omega_{et}^* > \omega_{ht}^*$,[4] both options generate equal payoffs. $\log \omega_{et}^*$ is smaller than one if and only if $t\theta_h[1 - \log \omega_{ht}^*] + \gamma < \delta - 1$, a condition that may or may not be satisfied.[5] If it is not satisfied, no firm will export.

Suppose that $\log \omega_{et}^* < 1$, and we have some firms selecting into exports. Condition (A4) ensures that for firms of ability ω_{et}^* or slightly above, home production generates (weakly) lower profits than the loss arising from producing for both markets (which is bounded below by β, which is the proportional

[4]This threshold is obtained by solving the equation $\Pi_{et}(\omega_{et}^*) = \Pi_{ht}(\omega_{et}^*)$.

[5]For instance if $\log \zeta$ is close enough to $1 - \sigma$, $\log \omega_{ht}^*$ is arbitratrily close to 1, and $\log \omega_{et}^*$ will exceed one. On the other hand, take any value of γ between $(\delta - 1)\frac{\log \zeta}{1-\sigma}$ and $\delta - 1$, and t sufficiently close to 0, whence $\log \omega_{et}^*$ will be smaller than 1.

loss of revenues on account of the fall in productivity resulting from lack of managerial time). Hence these firms will want to exclusively export. Firms with ability below ω^*_{et} will also specialize in home production (since over that range of ability, exporting is the less profitable activity and even generates even less profits than home production for firms of ability ω^*_{et}).

Finally, among the exporters, those with ability ω^*_{mt} are indifferent between specializing in exports and pursuing both home and export production. So at and above this ability, it is optimal for firms to pursue both activities.

3.3 Misallocation

Using as welfare criterion the sum of profits of all agents, it is evident that in the equilibrium: (a) too few firms are active, because entry of an additional firm increases profits of all other active firms, a positive externality that is not internalized by a firm at the margin of indifference between being active and not; and (b) too few active firms are exporting, because entry of an additional active firm into exporting increases profits of all other exporting firms, a positive externality not internalized by an active firm at the margin of indifference between exporting and not. The model therefore implies aggregate welfare benefits from subsidizing entry into both producing for the domestic market, and a higher subsidy for direct exports. We expect the optimal subsidy to be increasing in the strength of the network ties.

3.4 Testable Implications

To illustrate empirical implications of the model and how they compare with the facts for China, we extend the model to incorporate:

(i) **changes in relative product prices over time:** Normalizing the price of the agricultural good (in the traditional occupation) to unity, the price of the industrial good on the home market is $\hat{q}_{ht}$ which is rising in t, and on the export market is $\hat{q}_{xt}$ which is also rising in t. Specifically, the revenue function (1) for an entrepreneur in home and exports are modified to:

$$R_{ht} = (1-\alpha)C_{ht}[q_{ht}\omega]^{1-\alpha}K^{\alpha}_{ht}, R_{xt} = (1-\alpha)C_{xt}[q_{xt}\omega]^{\delta(1-\alpha)}K^{\alpha}_{xt} \tag{4}$$

where $q_{ht} \equiv [\hat{q}_{ht}]^{\frac{1}{1-\alpha}}, q_{xt} \equiv [\hat{q}_{xt}]^{\frac{1}{1-\alpha}}$.

(ii) **higher population density p corresponds to a right shift of the distribution of log ability, and higher network effects:** the distribution of log ability is uniform on the support

$[A(p), 1 + A(p)]$ where $A(p)$ is increasing in p, and network effects rise linearly in p so $\theta_h = p\eta_h, \theta_x = p\eta_x$.

Then thresholds for entry and exports are modified to:

$$\log \omega^*_{ht} = \frac{\log \zeta - q_{ht} - tp\eta_h}{1 - \sigma - tp\eta_h}$$
$$\log \omega^*_{et} = \frac{\gamma + (q_{ht} - \delta q_{xt}) + tp\eta_h\{1 + p - \frac{\log \zeta - tp\eta_h}{1-\sigma-tp\eta_h}\} - tp\eta_x}{\delta - 1 - tp\eta_x}$$

Selection into entry and exports respectively can therefore move in different directions over time depending on relative demand shifts. These do not necessarily reveal anything about the role of networks. If all networks had the same p, this would be the only source of variation in the thresholds. Hence we shall focus on the role of variations in p and $p * t$ instead, which will permit inference regarding the presence of underlying network effects, as we explain below.

The number of active firms at date t equals

$$N_t \equiv t[1 + A(p) - \log \omega^*_{ht}] = t[A(p) + \frac{1 - \sigma - \log \zeta + q_{ht}}{1 - \sigma - tp\eta_h}] \tag{5}$$

The **entrepreneurial propensity** is defined to be the ratio of active entrepreneurs to the number of potential entrepreneurs:

$$a_t \equiv \frac{N_t}{t} = 1 + A(p) - \log \omega^*_{ht} = A(p) + \frac{1 - \sigma - \log \zeta + q_{ht}}{1 - \sigma - tp\eta_h} \tag{6}$$

which is rising in p, t and $p * t$. In the absence of network effects ($\eta_h = 0$) this reduces to

$$a_t \equiv \frac{N_t}{t} = A(p) + \frac{1 - \sigma - \log \zeta + q_{ht}}{1 - \sigma} \tag{7}$$

which is rising in p, includes year effects but is independent of $p * t$. Hence *network effects imply a growing divergence between high and low p (as seen in Figures 4 and 7), while in their absence the divergence does not vary over time.*

The number of firms who are exporters equals

$$N_{xt} \equiv t[1 + A(p) - \log \omega^*_{et}] = t[A(p) + \frac{\delta - 1 - \gamma + (\delta q_{xt} - q_{ht}) - tp\eta_h(1 + A(p) - \log \omega^*_{ht})}{\delta - 1 - tp\eta_x}] \tag{8}$$

We define **export propensity** as the ratio of the number of exporters to the number of potential entrepreneurs:

$$x_t \equiv \frac{N_{xt}}{t} = A(p) + \frac{\delta - 1 - \gamma + (\delta q_{xt} - q_{ht}) - tp\eta_h(1 + A(p) - \log \omega^*_{ht})}{\delta - 1 - tp\eta_x} \tag{9}$$

which may be contrasted with the entrepreneurial propensity. In the absence of network effects, this reduces to

$$x_t \equiv \frac{N_{xt}}{t} = A(p) + \frac{\delta - 1 - \gamma + (\delta q_{xt} - q_{ht})}{\delta - 1} \tag{10}$$

which is rising in p, depends on year effects, and is independent of $p * t$ — just the same pattern exhibited by the entrepreneurial propensity. With network effects, (9) depends on both p and $p * t$ in a complicated way that depends on the relative importance of the home and export network effects. It is possible therefore that the export propensity does not vary significantly with p or $p * t$, if the home and export network effects neutralize one another. Or it could be decreasing in p and $p * t$ if the direct export network effect is dominated by the indirect negative incentive effect arising from a stronger home network effect. In such situations, the fraction of active entrepreneurs (rather than all potential entrepreneurs) that export will be decreasing in p. This is the pattern shown in Figures 5 and 8.

Next consider firms that do not specialize, the number of which equals

$$M_t = t[1 + A(p) - \log \omega^*_{mt}] = t[1 + A(p) - \beta - \log \zeta + t\lambda_h \theta_h \{1 - \log \omega^*_{ht}\} + t\lambda_x \{1 - \log \omega^*_{et}\}] \tag{11}$$

so the **mixed exporter propensity** is

$$\frac{M_t}{t} = 1 - \beta - \log \zeta + A(p) + p[\eta_h \lambda_h a_t + \eta_x (1 - \lambda_x) x_t] \tag{12}$$

In the absence of network effects, this is increasing in p but independent of t or $p*t$. With network effects this propensity is approximately a weighted average of the entrepreneurial and export propensities, with weights that could add up to less than one owing to the control losses.

Finally consider predictions for revenues (which is very similar to the corresponding expression for capital size, so is a reasonable proxy for firm size). For an entrepreneur with ability ω operating on the home market (i.e., between thresholds $\log \omega^*_{ht}$ and $\log \omega^*_{et}$), log revenue at t equals

$$\log R_{ht}(\omega) = \alpha\psi + \log(1 - \alpha) + \log \omega + \frac{1}{1 - \alpha} \eta_h p t a_t + \log q_{ht} \tag{13}$$

where $\psi \equiv \frac{1}{1-\alpha}[\log \alpha + \log(1 - \alpha) - \log r]$. Besides a constant intercept term, each is the sum of three effects, depending respectively of the entrepreneur's ability, the size of the active network, and the time-varying demand. Controlling for the entrepreneur's ability, the dynamics of revenues are driven by the dynamics of network size and demand respectively. Firm size growth is driven by the growth of network size (i.e., a_t). *As a_t is rising in p, t and $p * t$, the same is true for firm size and revenues* *for those specializing in home production. In the absence of network effects, a regression controlling for firm and year dummies should be independent of p and t.*

The corresponding expressions for revenues of an entrepreneur that specializes in exports are:

$$\log R_{et}(\omega) = \alpha\psi' + \log(1-\alpha) + \log\omega + \frac{1}{1-\alpha}\eta_x ptx_t + \delta\log q_{et} \tag{14}$$

where $\psi' \equiv \psi - \log(1+I)$ the intercept term is smaller on account of the higher capital costs involved in exporting. Again the ability, network and demand effects enter additively. Controlling for the entrepreneur's ability, the firm size dynamics for exporters differs from that of home producers in the same way that the dynamics of network sizes differ. The latter depends in turn on the difference in dynamics of the activity propensity a_t and export propensity x_t. The former is rising in $p * t$ while the latter need not be. In particular, export revenues should be growing more slowly than revenues of home producers (this follows from observing that the growth rate of home revenues is $\frac{\eta_h a_t p}{1-\alpha}$, of export revenues is $\frac{\eta_x x_t p}{1-\alpha}$, and we have $\eta_h \geq \eta_x, a_t > x_t$). Moreover the hypothesis of weaker spillover effects in exports than home production ($\eta_h > \eta_x$) implies that the coefficient of $p * t$ should be lower for export revenues.

If there are no network effects in either home production or exports, these differences vanish: revenues would be independent of p and $p * t$ once we control for firm and year dummies.

For mixed types the revenue expression is qualitatively similar to the sum of corresponding expressions for pure home producers and pure exporters, weighted by the respective control losses.

3.5 Extension to Irreversible Sector Choices

Now assume that an entrepreneur is committed to a sector choice at the point of entry, and makes these decisions myopically. Also assume that help within the network is provided to newcomers by members who have entered at previous dates, as in our previous model. Then the model is totally recursive. Let $n_{t-1}, n_{x,t-1}$ denote the number of active and exporting entrepreneurs from the same hometown who have entered by the end of $t-1$. Then $C_{ht} = \exp(\theta_h n_{t-1}), C_{xt} = \exp(\theta_x n_{x,t-1})$. This implies profits for a new entrant with ability ω equals

$$\begin{aligned}
\Pi_0(\omega) &= \sigma\log\omega \\
\Pi_{ht}(\omega) &= \log\omega + \theta_h n_{t-1} - \log\zeta \\
\Pi_{et}(\omega) &= \delta\log\omega + \theta_x n_{x,t-1} - \log\zeta - \gamma
\end{aligned}$$

where we abstract from mixed exporters for the time being. We then obtain the following thresholds for ability for specializing in the home market and exporting respectively:

$$\begin{aligned}
\log \omega_{ht}^{*} &= \frac{\log \zeta - \theta_h n_{t-1}}{1-\sigma} \\
\log \omega_{et}^{*} &= \frac{\log \zeta + \gamma + \theta_h n_{t-1} - \theta_x n_{x,t-1}}{\delta - 1}
\end{aligned}$$

These thresholds are ordered as in the baseline model (implying the existence of pure home producers of low ability, pure exporters of intermediate ability) if $\theta_h \geq \theta_x, \delta - 1 \leq 1 - \sigma$.

Entry flows into entrepreneurship and exporting are as follows:

$$\begin{aligned}
E_t &= 1 + A(p) - \frac{\log \zeta}{1-\sigma} + \frac{1}{1-\sigma}\theta_h n_{t-1} \\
E_{xt} &= 1 + A(p) - \frac{\log \zeta + \gamma}{1-\sigma} - \frac{1}{\delta - 1}[\theta_h n_{t-1} - \theta_x n_{x,t-1}]
\end{aligned}$$

Observe in particular in how a large number of home producers depresses entry into exports. This is particularly evident when $\theta_x = \theta_h$. This implies that the total number of entrepreneurs and exporters at date t are:

$$\begin{aligned}
n_t \equiv n_{t-1} + E_t &= [1 + A(p) - \frac{\log \zeta}{1-\sigma}][1 + (1 + \frac{\eta_h p}{1-\sigma}) + .. + (1 + \frac{\eta_h p}{1-\sigma})^{t-1}] + [1 + \frac{\eta_h p}{1-\sigma}]^t n_0 \\
n_{xt} \equiv n_{x,t-1} + E_{xt} &= [1 + A(p) - \frac{\log \zeta + \gamma}{\delta - 1}][1 + (1 + \frac{\eta_x p}{\delta - 1}) + .. + (1 + \frac{\eta_x p}{\delta - 1})^{t-1}] + [1 + \frac{\eta_x p}{\delta 1}]^t n_0 \\
&+ \sum_{l=1}^{t-1} (\frac{\eta_h p}{1-\sigma})^{t-l} (1 + \frac{\eta_x p}{\delta - 1})^l n_{t-l}
\end{aligned}$$

Hence the entrepreneurial propensity is again rising in p and $p * t$, while the export propensity may be falling in $p * t$ (even if network effects in home production are somewhat weaker than in exports). In the absence of network effects, both are rising in p and independent of $p * t$:

$$\begin{aligned}
\frac{n_t}{t} &= 1 + A(p) - \frac{\log \zeta}{1-\sigma} + n_o \\
\frac{n_{xt}}{t} &= 1 + A(p) - \frac{\log \zeta + \gamma}{\delta - 1} + n_{xo}
\end{aligned}$$

4 Testing Predictions for Firm Size Distribution

In this section we test reduced form predictions of the model concerning the firm size distribution and its dynamics. Table 1 shows the number of firms specializing in home production and exports, those that do both, and the average per firm revenue of each category in the two firm Census years 2004 and 2008. Most firms specialize on the home market, earning low revenues relative to exporters. Pure exporters (defined by a ratio of export revenues to total revenues in excess of 90%) constitute 80-85% of all exporting firms, and earn considerably higher per firm revenue compared to home producers. Mixed exporters earn the highest revenues. These are in line with the sorting pattern in the model.

Table 1. Domestic firms, Pure exporters and Mixed firms: Based on Census Data

Year	2004		2008	
Variable:	number	ln(revenue)	number	ln(revenue)
Pure domestic production firm	314794	0.13	572107	0.59
Pure exporter	805	1.46	2621	1.18
Mixed firm	5697	2.70	13017	2.63

Note: by comparing total revenue from the Firm Census Data and exporting revenue from the Customs data, we separate firms into pure domestic firms, pure exporters and mixed firms. Pure exporters have a fraction of exporting revenue over total revenue larger than 90 %.

Next, Table 2 shows regressions at the birth-county-year level for entrepreneurial and export propensity that correspond to (6) and (9) respectively. These are regressed on year (t), PD (p) and interactions of PD with t and t^2. Both OLS and 2SLS specifications are shown with crop suitability as an instrument for PD. As seen previously in Figure 7, columns 1 and 2 show entrepreneurial propensity is rising in p and $p * t$. We see here it is also rising in $p * t^2$. Columns 3 and 4 pertain to the export propensity. Like entrepreneurial propensity it is rising in p, $p * t$ and $p * t^2$, but the magnitude of the coefficients is significantly smaller. This is what we would expect from the model in the presence of network effects.

Table 3 reports similar regressions for the mixed and pure exporter propensity, based on the two Census years 2004, 2008 when we can distinguish pure from mixed exporters. The results are compared with entrepreneurial propensity when restricted to those two years. Consistent with the model's predictions, the results for mixed exporter propensity are intermediate between those for entrepreneurial and pure exporter propensity. Mixed exporters constitute a high ability subset of all exporters, with an ability threshold defined by a zero marginal profit impact of operating a home market oriented business on top of the export business. Hence a large home network generates a bigger stimulus to the mixed export propensity compared to the pure export propensity.

We turn now to testing the predictions concerning dynamics of firm revenues. Table 4 displays log revenue regressions for home producers and exporters respectively, on p, t and $p * t$, both with and without firm fixed effects, for both OLS and 2SLS specifications. Consistent with the predictions of

Table 2. Entrepreneurial Propensity, Export Propensity, and PD

Model:	OLS	2SLS	OLS	2SLS
Propensity to:	become an entrepreneur		export	
	(1)	(2)	(3)	(4)
PD	0.002	0.006	0.001***	0.001***
	(0.004)	(0.003)	(0.000)	(0.000)
PD*Time	0.013***	0.006**	0.001***	0.000***
	(0.003)	(0.002)	(0.000)	(0.000)
PD*Time square	0.001***	0.002***	0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Time	-0.002	-0.002	0.001***	0.001***
	(0.002)	(0.002)	(0.000)	(0.000)
Time square	0.007***	0.007***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	21,824	21,824	10,912	10,912

Note: Entrepreneurial propensity at birth county-year level is measured as the ratio of the number of surviving firms to the population of males aged between 25 and 55 from 1994-2009. Export propensity is measured as ratio of the number of exporting firms over the population of males aged between 25 and 55 from 2002-2009. PD is population density from the 1982 Census. Time is an ordinal variable starting from 0. It ranges from 0 to 15 for regressions on propensity to become an entrepreneur and from 0 to 7 for regressions on propensity to export. The first stage regression in the 2SLS results predicts the 1982 population density and interaction terms by crop suitability and its interaction terms with time and time square. The second stage regression uses the predicted population density and interaction terms as regressors. The crop suitability is measured at the county level based on 1990 China GIS map, following Galor and Ozak (2016). Entrepreneurs' and exporters' information is from Business Registry Database and Chinese Customs Database. Population in 1994-1999 is from the 1990 Census and that in 2000-2009 is from the 2000 Census. Standard errors clustered at birth county level are reported in parentheses. * significant at 10%, ** at 5%, *** at 1%.

Table 3. Entrepreneurial, Mixed Exporter and Pure Exporter Propensity, Firm Census Data

Model	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
	entrepreneurial propensity			mixed exporter propensity			pure exporter propensity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PD	0.269***	0.223***	0.117***	0.015***	0.013***	-0.005	0.002***	0.001***	-0.002**
	(0.033)	(0.025)	(0.039)	(0.003)	(0.003)	(0.006)	(0.001)	(0.000)	(0.001)
PD*Time	0.155***	0.152***	0.140***	0.021***	0.017***	0.016***	0.005***	0.004***	0.004***
	(0.022)	(0.015)	(0.015)	(0.007)	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)
Time	0.618***	0.618***	0.555***	0.032***	0.032***	0.026***	0.008***	0.008***	0.006***
	(0.017)	(0.017)	(0.035)	(0.003)	(0.003)	(0.006)	(0.001)	(0.001)	(0.002)
Control	No	No	Yes	No	No	Yes	No	No	Yes
# Obs.	2,728	2,728	2,728	2,728	2,728	2,728	2,728	2,728	2,728

Note: We distinguish pure domestic firms, pure exporters and mixed firms by comparing total revenue from the 2004 and 2008 Firm Census and exporting revenue from the Customs data for those years. Pure exporters have a fraction of exporting revenue over total revenue larger than 90 %. Mixed (pure) exporter propensity is measured at birth county level as ratio of mixed (pure) exporters over working male population in the manufacturing industry in 2004 and 2008. PD is population density from the 1982 Census. Time is an ordinal variable starting from 0. The first stage regression in 2SLS results predicts the 1982 population density and interaction terms by crop suitability and its interaction terms with time and time square. The second stage regression uses the predicted population density and interaction terms as regressors. Crop suitability is measured at the county level based on 1990 China GIS map, following Galor and Ozak (2016). 2SLS with controls adds controls for distribution across education, industry and occupation categories for each birth county. Entrepreneurs' and exporters' information is from Business Registry Database, Firm Census Data and Chinese Customs Database. Population in 2000-2009 is from the 2000 Census. Standard errors clustered at birth county level are reported in parentheses. * significant at 10%, ** at 5%, *** at 1%.

the model with network effects, we see in all these specifications that export revenues grow more slowly over time, and the coefficient of $p*t$ for export revenues is substantially smaller than for home revenues.

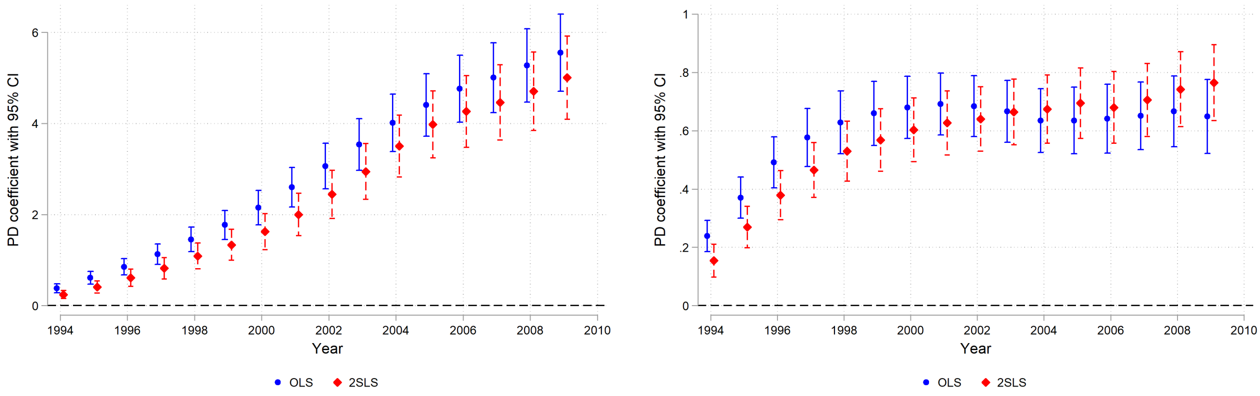
Table 4. Domestic Revenue, Exporting Revenue, and PD

Dependent variable:	Ln (domestic revenue)			Ln(exporting revenue)		
Period:	1998-2009			2002-2009		
Model:	OLS	2SLS	2SLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
PD	-2.315***	-3.507***		0.042	0.072*	
	(0.417)	(0.509)		(0.029)	(0.042)	
PD*Time	0.184***	0.275***	0.345***	0.007*	0.004	0.018***
	(0.042)	(0.055)	(0.002)	(0.004)	(0.006)	(0.004)
Time	0.599***	0.591***	0.991***	0.063***	0.063***	0.234***
	(0.041)	(0.043)	(0.002)	(0.006)	(0.006)	(0.003)
Observations	3,541,507	3,541,507	3,541,507	82,270	82,270	82,270
Firm FE	No	No	Yes	No	No	Yes

Note: Domestic revenue is from the Inspection Data 1998-2009 and exporting revenue is from the Chinese Customs Data 2002-2009. PD is population density from the 1982 Census. Time is an ordinal variable starting from 0. It ranges from 0 to 11 for regressions on domestic revenue and from 0 to 7 for regressions on exporting revenue.
The first stage regression in 2SLS results predicts the 1982 population density and interaction terms by the crop suitability and its interaction terms with time and time square. The second stage regression uses the predicted population density and interaction terms as regressors. The crop suitability is measured at the county level based on 1990 China GIS map, following Galor and Ozak (2016). Standard errors clustered at birth county level are reported in parentheses. * significant at 10%, ** at 5%, *** at 1%.

5 Corroborating Evidence

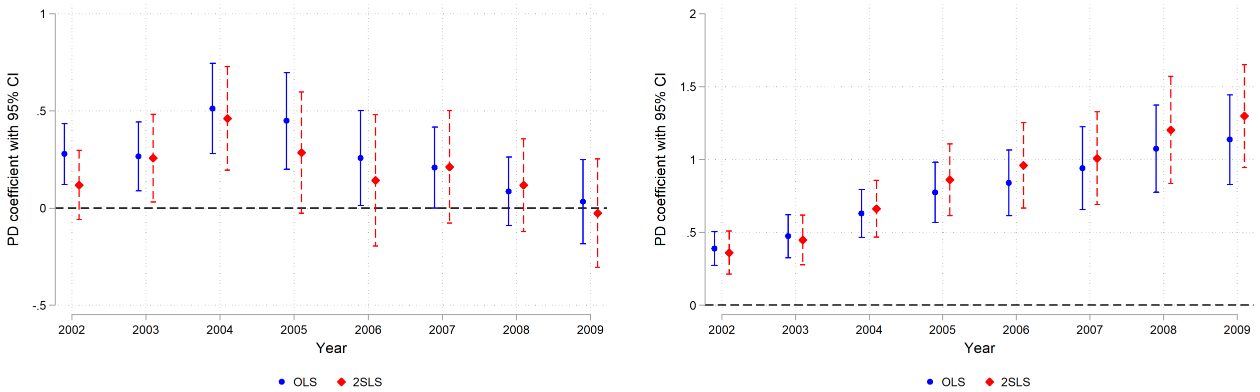
Dai et al (2020a) present evidence that counties with higher population density exhibit higher levels of informal social interactions, and trust in fellow residents. Moreover entrepreneurs from higher density birth counties showed higher levels of partnership in jointly owned firms, and higher levels of 'support' in networks based on partnership links. They were more narrowly concentrated in fewer locations and fewer sectors, which is what one would expect with hometown network based productivity spillovers, and access to information and referrals. The theoretical model in that paper incorporated choice of multiple destinations and showed how network based referrals and spillovers would generate higher concentration in networks with stronger network ties, and that the differences in these effects would increase over time.



(a) HHI across Destinations

(b) HHI across Industries

Figure 9. HHI across Destinations and Industries for Domestic Firms: PD Coefficient by Year
Note: spatial concentration is measured across destination prefectures (outside the birth county) and sectoral concentration is measured across 2-digit industries. Concentration statistics are adjusted for expected concentration due to random assignment. PD coefficients of regressions at county level in each year with different specifications are reported. 2SLS specification uses crop suitability as an instrument variable for PD. Population density is from the 1982 Census. Standard errors are clustered at birth county level.



(a) HHI across Destinations

(b) HHI across Goods

Figure 10. HHI across Destinations and Goods for Exporting Firms: PD Coefficient by Year
Note: spatial concentration is measured across destination countries and sectoral concentration is measured across HS code 6-digit goods. Concentration statistics are adjusted for expected concentration due to random assignment. PD coefficients of regressions at county level in each year with different specifications are reported. 2SLS specification uses crop suitability as an instrument variable for PD. Population density is from the 1982 Census. Standard errors are clustered at birth county level.

However their spatial analysis focused on locations within China, and thus did not explore patterns of concentration among exporting firms. Our preceding analysis was based on the assumption of network effects for both home producers as well as exporters (both of which are rising in birth county PD), with stronger spillovers among the home producers. This assumption ought to imply: (i) that the effect of PD on spatial and product concentration should be positive and rising over time both among domestic producers and among exporters, and (ii) these effects should be larger among domestic producers. We test these predictions below.

Figures 9a and 9b respectively show the PD coefficient in regressions of a (standardized) Hirschman-Herfindahl index (HHI) of concentration across locations and industries for each year between 1994-2009 for domestic producers. Figures 9a and 9b show the corresponding regression coefficients for exporters for years between 2002-09. However, for exporters we examine product concentration using a 6 digit HS code, which is substantially more disaggregated than the two digit industry concentration used for domestic producers. Hence the sectoral/product concentration indices are not comparable between the domestic firms and exporters. Results for both OLS and 2SLS specifications are shown, with crop suitability as an instrument for PD in the latter. For domestic producers we find a significant positive and rising PD effect on both spatial and sectoral concentration. For exporters the effects of PD on locational concentration tends to smaller and insignificant for most years. However, the product concentration index is significantly increasing in PD for exporters, and tends to be higher in later years. Hence we do see evidence consistent with the presence of network effects among exporters, though it is difficult to compare these effects with those for domestic producers.

6 Conclusion

In summary, we documented a striking dissimilarity in patterns of selection into entrepreneurship and into exporting among Chinese entrepreneurs. Birth counties with higher population density (PD) exhibited higher levels and growth of entrepreneurship, but falling selection of active firms into exporting activity. This was robust with respect to inclusion of controls for education and occupational patterns, and checks for possible measurement error in PD or reverse causality. This provides evidence against the hypothesis that PD is a proxy for unobserved ability, wealth or other attributes stimulating entrepreneurship. We developed a theoretical model explaining the observed patterns on the basis of stronger birth county-network-based spillovers among domestic producers than among exporters, and presented evidence corroborating this explanation. This explanation suggests that while industrial development may be stimulated by informal community networks, it can also generate a misallocation whereby the increased profitability of low value activities discourages choice of higher value (exporting) activities.

Specifically, the equilibrium involves too little entry into both entrepreneurship and export activities, thereby suggesting that growth enhancing policies would require subsidies for domestic entrepreneurs and higher subsidies for exporters. This suggests the need for structural estimation of the parameters of the model in order to estimate the effects of such policies. A suitable structural model would involve incorporating a number of 'realistic' details such as capital adjustment or switching costs into the model, which remains a challenging task for future research.

References

Au C. and V. Henderson (2006), 'Are Chinese Cities Too Small?', Review of Economic Studies, 73(3), 549-576.

Calvo G. and S. Wellisz (1978), 'Supervision, Loss of Control and Optimal Size of the Firm,' Journal of Political Economy, 86, 943-952.

Ciccone A. and R. Hall (1996), 'Productivity and the Density of Economic Activity,' American Economic Review, 86(1), 54-70.

Dai R., D. Mookherjee, K. Munshi and X. Zhang (2020), 'Community Networks and the Growth of Private Enterprise in China,' working paper, Boston University, http://people.bu.edu/dilipm/wkpap/Chinaoveral

Fisman R., J. Shi, Y. Wang and R. Xi (2018), 'Social Ties and Favoritism in Chinese Science,' Journal of Political Economy, 126(3), 1134-1171.

Galor O. and O. Ozak (2016), 'The Agricultural Origins of Time Preference,' American Economic Review, 106(1), 3064-3103.

Hanlon W. and A. Miscio (2017), 'Agglomeration: A Long-Run Panel Data Approach,' Journal of Urban Economics, 99, 1-14.

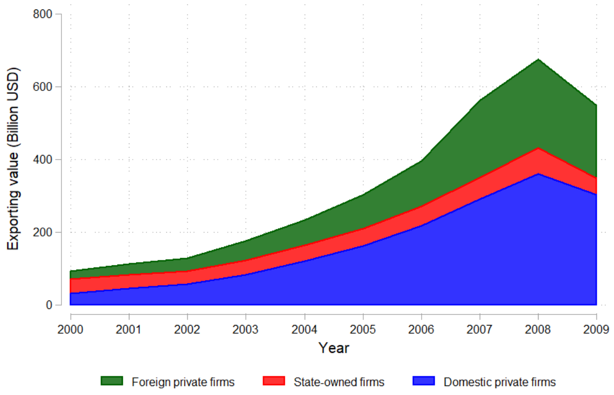
Lucas R. (1978), 'On the Size Distribution of Business Firms,' Bell Journal of Economics, 9(2), 508-523.

Melitz, M. (2003), 'The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,' Econometrica, 71(6), 1695-1725.

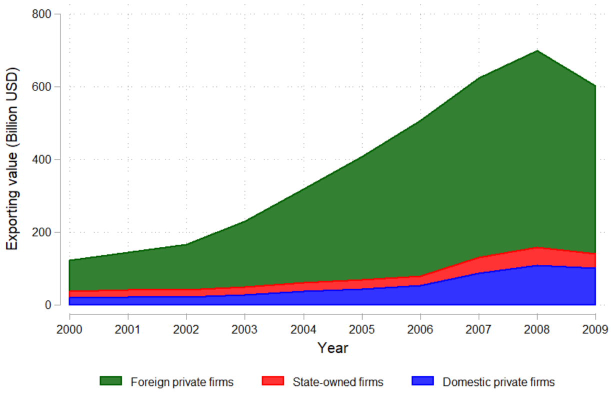
Peng, Y. (2004), ‘Kinship Networks and Entrepreneurs in China’s Transitional Economy,’ American Journal of Sociology, 109(5), 1045-1074.

Williamson O. (1967), ‘Hierarchical Control and Optimal Firm Size,’ Journal of Political Economy, 75, 123-138.

Appendix Figures and Tables



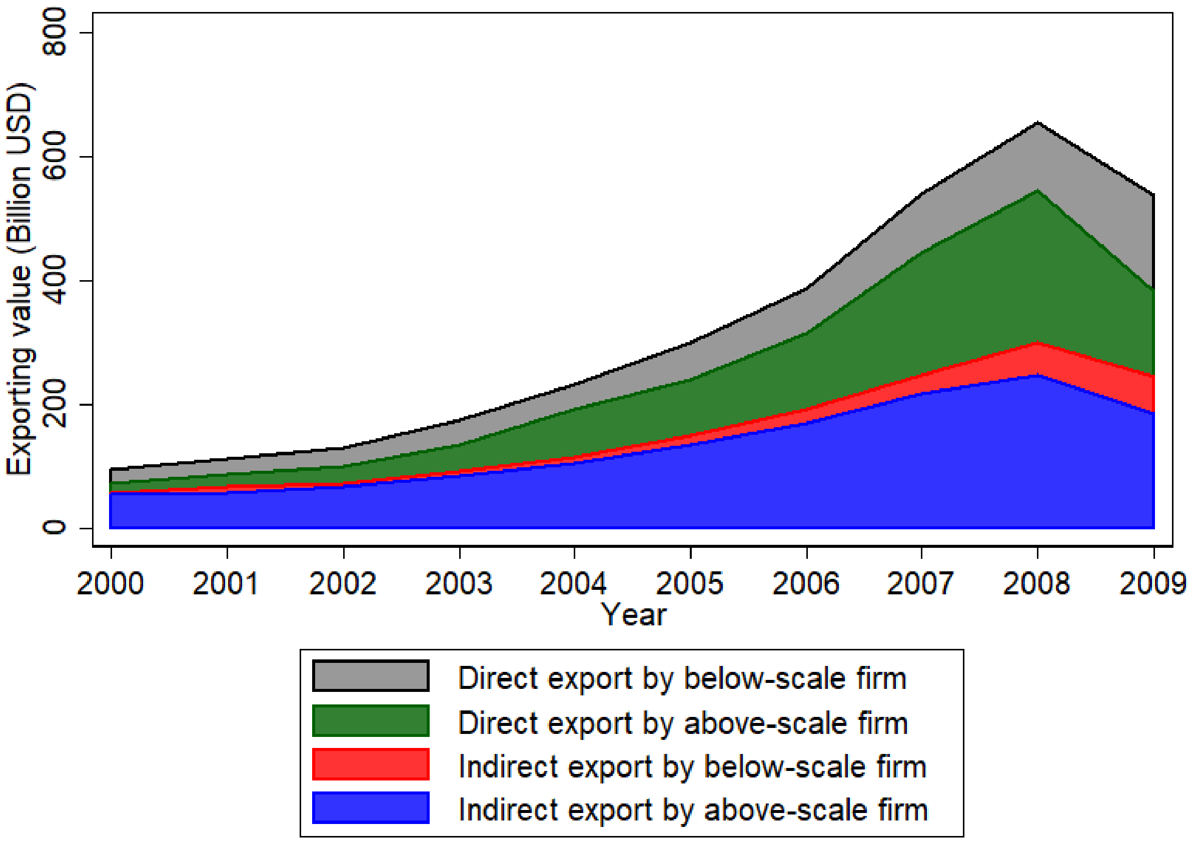
(a) Production export



(b) Processing export

Appendix Figure A1. Production and Processing Export, by Ownership

Source: Authors' calculations using Chinese Customs Database and Business Registry Database.



Appendix Figure A2. Direct and Indirect Production Export, By Firm Type

Source: Authors' calculations using Chinese Customs Database, the Above-Scale Industrial Enterprise (ASIE) Database and the Business Registry Database.

Indirect exporting revenue by above-scale firm is the difference between the total exporting revenue from the ASIE Database and the direct exporting revenue from the Customs Database. Indirect export by below-scale firms is calculated as the total exporting revenue of trading firms minus by the sum of direct exporting revenue of all production firms and the indirect exporting revenue by above-scale firms.

Appendix Table A1. Price and OECD Destination, By Production Exporters and Trading Firms

Dependent variable:	price	OECD countries
	(1)	(2)
Trading firms	-15.857***	-0.074***
	(1.459)	(0.000)
Constant	82.018***	0.474***
	(1.349)	(0.000)
Observations	9,062,560	9,062,560
Goods-Year FE	Yes	Yes

Note: Price and OECD Countries Dummy at firm-goods level is from the Customs Database. Trading firms are identified as firms in wholesale and retail industry which have positive exporting revenue.
Goods-year fixed effects are included as controls.
Robust standard errors are reported in parentheses. * significant at 10%, ** at 5%, *** at 1%.