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Entrepreneurship in China: The role of localisation and urbanisation economies

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Abstract

Why are some regions more entrepreneurial than others? This study explores the determinants of manufacturing entrepreneurship at the prefectural city level in China by highlighting the influence of localisation and urbanisation economies and the significance of technological relatedness and small firm clusters. Descriptive analysis has reported significant and increasing spatial variation of manufacturing entrepreneurship in China during 2001–2007. The empirical results based on the negative binomial model provide evidence to support the business network view of entrepreneurship. Localisation economies can predict entrepreneurship well, while the effects of urbanisation economies are mixed. In terms of localisation economies, supplier/customer linkages play a very important and positive role in cultivating entrepreneurship. The mixed results of urbanisation economies are mainly derived from the interweaving of related variety and unrelated variety. The former significantly promotes entrepreneurship, while the latter in most cases discourages entrepreneurship. The clustering of small firms has a larger effect on entrepreneurship, which is consistent with the view of Vernon and Chinitz effect.

Keywords

entrepreneurship, localisation economies, related variety, urbanisation economies, Vernon-Chinitz effect

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Introduction

Entrepreneurship is essential for the continuing vitality of the modern economy. A higher

entry rate of new businesses is a fundamental driver of sustainable economic growth (Djankov et al., 2002). Entrepreneurship, however, is also a spatially uneven process, and thus a significant explanation of regional economic disparity (Stam, 2010). Silicon Valley appears more entrepreneurial than the declining cities of the Rust Belt in the USA (Glaeser and Kerr, 2009). A distinct spatial difference of entrepreneurship exists in India (Ghani et al., 2013). Likewise, some coastal cities in China appear more entrepreneurial than inland cities. To explain why entrepreneurship is spatially uneven, previous studies have mainly focused on individual characteristics of potential entrepreneurs such as their location choice preference, age, sex and educational level (Armington and Acs, 2002; Bates, 1990; Cooper and Folta, 2000; Delfmann et al., 2014; Elert, 2014; Michelacci and Silva, 2007; Stam, 2007). However, it would be difficult for talented entrepreneurs to start a business without a favourable external environment (Stam, 2010).

Recently, there has been a growing debate on the role of regional economic environment, especially industrial clusters and agglomeration economies, in the shaping of entrepreneurship in developed countries (Feldman, 2001; Glaeser and Kerr, 2009; Porter, 1990, 1998a, 1998b; Saxenian, 1994). They stress the importance of localisation economies and urbanisation economies to the birth of new businesses (Henderson, 2003; Rosenthal and Strange, 2003, 2004). However, it is far from enough in agglomeration studies to distinguish only localisation economies from urbanisation economies. Further studies on the internal structure of agglomeration economies are increasingly necessary. First, a rising body of literature in Evolutionary Economic Geography introduces the notion of technological relatedness to redefine the boundary of knowledge spillovers and rethink the agglomeration effect. Knowledge spillovers are more likely to exist across technologically related industries rather than across unrelated industries and same industries (Boschma, 2005), because interactive learning between firms is more efficient when there is some degree, not too much or too little, cognitive proximity between firms (Nooteboom, 2000). Technological relatedness is also considered as a key factor for entrepreneurial activities (Feldman et al., 2005; Glaeser and Kerr, 2009). Although they refer to the importance of technological relatedness in explaining entrepreneurship, few studies measure accurately technological relatedness in entrepreneurship studies. Second, some attention has been paid to the role of small firms in the generation of agglomeration economies (Chinitz, 1961; Piore and Sabel, 1984; Saxenian, 1994; Vernon, 1960). The important role of small firm clusters was first put forward by Vernon (1960) and Chinitz (1961) and then was coined as 'the Vernon-Chinitz effect' in the literature (Glaeser et al., 2010; Rosenthal and Strange, 2010). In these studies, average firm size or the Hirshmann-Herfindahl index is often measured to investigate the effect of small firms. However, the measurements cannot accurately reflect the real role of these small firms.

The main goal of this study is to examine the explanatory power of agglomeration economies and its internal structure in manufacturing entrepreneurship in China. The gradually accelerating process of China's economic reform has unleashed the emerging power of entrepreneurship, which is increasingly critical for China's economic development. Institutional transformation such as the process of marketisation, decentralisation and globalisation (He et al., 2008), not only provide more market opportunities but also impose more serious

challenges for Chinese entrepreneurs. Facing complex and uncertain institutional environments, entrepreneurs are more inclined to locate in clusters with production networks and knowledge spillovers. This study is among the first to explore the effect of agglomeration economies on manufacturing entrepreneurship in China by highlighting the role of technological relatedness and small firm clusters. Moreover, most variables in this study are measured at the three-digit sector level and at the prefectural city level, so we can control the sectoral and spatial variations of entrepreneurship.

Literature review and hypothesis development

The impact of localisation and urbanisation economies on entrepreneurship

Agglomeration economies are often divided into localisation economies and urbanisation economies in prior literature (Henderson, 1997; Moomaw, 1988; Viladecans-Marsal, 2004). Localisation economies stem from the clustering of firms within the same industry in the local economy, which generates external economies available to local firms through labour market pooling, input–output linkage and specialised knowledge spillovers (Marshall, 1920). Compared with incumbent firms, new entries are more dependent on localisation economies, since new firms are unfamiliar with local production networks, and have not built strong ties with local suppliers and may be short of local knowledge on workforce, business management, technology and the market (Stinchcombe, 1965). Therefore, local supplier/customer linkages, specialised labour pooling and knowledge spillovers could make it easier for potential entrepreneurs to overcome their initial liabilities (Ghani et al., 2013).

Localisation economies enable new firms to share local input suppliers (input sharing) and local clients with incumbents, cutting transportation costs and lowering entry barriers. Krugman (1991) also stresses that access to consumers could reduce shipping costs. Proximity to buyers and sellers could build the trust relationship during the economic transaction to improve translation efficiency and reduce transaction costs (Romero-Martínez and Montoro-Sánchez, 2008). Porter (1990) further emphasises that proximity to customers and suppliers could enhance innovation through knowledge spillovers. Moreover, a large number of suppliers and customers located in a specific area can help entrepreneurs find suppliers and buyers more efficiently and thus reduce searching costs (Stuart, 1979). Therefore, we would pay more attention to customer/supplier linkages in several mechanisms of agglomeration effects. This leads to the following research hypotheses:

Hypothesis 1 (H1): Localisation economies are beneficial to entrepreneurship.
Hypothesis 2 (H2): Cities with more supplier/customer linkages provide a more favourable environment for entrepreneurship in China.

Urbanisation economies arise when firms benefit from the concentration of various industries in the local economy. Jacobs (1969) argues that a wealth of industrial diversity in urban areas is the most important source of knowledge spillovers. The cross-fertilisation incubated by industrial variety enhances innovation and entrepreneurial success (Duranton and Puga, 2001). The term Jacobs externalities was coined by Glaeser et al. (1992) to capture the inter-industry spillover benefits from local diversity. Van Stel and Suddle (2008) find that Jacobs externalities provide niche markets

and more opportunities for success, leading to a higher rate of new firm formation.

When comparing the significance of localisation economies and Jacobs externalities, most studies (e.g. Combes et al., 2004; Henderson, 1997) support the importance of localisation argument, while the role of Jacobs externalities is not as well established. Rosenthal and Strange (2003) report that localisation effects are more important than urbanisation effects in nearly all of the cases for both births and new-firm employment. The role of Jacobs externalities is ambiguous in the prior empirical studies, but we still propose the following research hypothesis according to the above theoretical analysis:

Hypothesis 3 (H3): Jacobs externalities may encourage entrepreneurship in China.

The impact of related variety and unrelated variety

Knowledge spillovers among a great diversity of industries within a region are a major source of Jacob's externalities. Can knowledge, however, flow efficiently between any industry? Since the important contribution of Boschma (2005), there has been an increasing awareness that relational proximity between economic agents is different from geographic proximity. Cognitive proximity is more important than geographical proximity for information spillover. Technological relatedness occurs when firms in a region operate within technologically related industries that have overlapping knowledge bases (Boschma and Frenken, 2011). Boschma and Frenken (2011) argue that local knowledge spillovers are more likely to occur within regions hosting a large number of technologically related industries. Interactive learning between firms is more efficient when there is some degree but not too much cognitive proximity between firms (Nooteboom, 2000).

Frenken et al. (2007) find that the effect of Jacobs externalities is higher in regions with a related variety of sectors than in regions with an unrelated variety of sectors. Technological relatedness is an important driver of the birth and evolution of new technologies, new product, and even new industries and clusters (Boschma and Frenken, 2006). Knowledge spillovers between related industries make it easier for potential entrepreneurs to find new technologies or markets, and finally establish new firms. Moreover, specialising in technologically related industries can reduce a number of uncertainties that new firms are usually confronted with (Nelson and Winter, 1982). An increasing number of studies have supported the influence of technological relatedness on industrial clustering (Boschma and Weterings, 2007), plant survival (Neffke et al., 2012) and regional growth (Frenken et al., 2007), but rarely on entrepreneurship. This leads to the following research hypothesis:

Hypothesis 4 (H4): Compared with unrelated variety, related variety has a larger effect on entrepreneurship.

The Vernon-Chinitz effect

Debates on the role of small firms in the generation of agglomeration economies have a long tradition. Vernon (1960) and Chinitz (1961) were the first to focus on the relationship between industrial organisation and agglomeration economies. They notice that the larger effect of agglomeration economies arise in clusters with more small firms. The clustering of small firms is conducive to fostering supplier–customer linkages and to enhancing innovation by knowledge spillovers, which are a very important source of agglomeration economies. The notion that small firms play a larger role in agglomeration economies was first put forward by Vernon (1960) and Chinitz (1961), so it was

also known as 'The Vernon-Chinitz effect'. Other scholars have also made important contributions on this effect (Jacobs, 1969; Piore and Sabel, 1984; Saxenian, 1994).

Previous studies have provided some important explanations for the Vernon-Chinitz effect. First, small firms are likely to share local specialised suppliers with other local firms to reduce production costs, so specialised and independent suppliers survive more easily in regions with an abundance of small firms, which would be favourable for the birth of new firms (Chinitz, 1961; Glaeser and Kerr, 2009; Rosenthal and Strange, 2003; Vernon, 1960). From the perspective of spillover effect, networking among firms may be more sparse in the regions where large firms dominate, which lowers knowledge spillovers among firms in that local industry (Chinitz, 1961; Glaeser et al., 1992; Malmberg and Maskell, 2002; Saxenian, 1994). Second, employees of small firms would be more likely to start a business because they not only engage in different types of tasks to accumulate a wealth of managerial experience about how to start and run small firms, but they are also exposed to network and business environments which are conducive to small firms (Dobrev and Barnett, 2005; Gompers et al., 2005; Johnson and Cathcart, 1979; Parker, 2009). Third, the wage for which entrepreneurs work before self-employment is the opportunity cost of self-employment (Acs and Armington, 2006). Small firms generally pay lower salaries than large firms, so employees are more likely to quit small firms than large ones to start their own businesses. Fourth, a large presence of small firms signifies a friendly business environment that encourages new firm formation, because regions dominated by small firms have lower entry barriers for new firms (Chen, 2012; Santarelli and Sterlacchini, 1994). Moreover, small incumbent firms provide successful role models for potential entrepreneurs (Parker, 2009; Stuart and Ding, 2006).

A few empirical studies have supported that small firms incubate effectively new entrepreneurial ventures (Acs and Armington, 2006; Armington and Acs, 2002; Glaeser and Kerr, 2009; Glaeser et al., 2010; Johnson and Cathcart, 1979; Qian and Haynes, 2014; Reynolds et al., 1994; Rosenthal and Strange, 2003, 2010). The empirical evidence on the role of small firms is largely from developed economies. Does the Vernon-Chinitz effect even exist in China? Does it increase the probabilities of entrepreneurship? This leads to the following research hypothesis:

Hypothesis 5 (H5): The clustering of small firms has a larger effect on entrepreneurship than the clustering of large firms does in China.

Data sources and measurements

Data sources

Data used in this study are compiled from the Annual Survey of Industrial Firms (ASIFs) provided by the State Statistical Bureau in China, which includes all state-owned industrial enterprises and non-state-owned enterprises with sales revenues greater than five million Yuan. Industries in this data set include mining, manufacturing, and electricity, gas and water production. This study focuses on manufacturing industries, whose three-digit SIC codes are from 131 to 421 during 2001–2007. There are 162 three-digit sectors and 286 prefecture-level cities. There are 325,458 observations in the sector-city balanced panel data over the period 2001–2007.

Measuring entrepreneurship

Entrepreneurship is defined as new firm formation in a large number of empirical studies, so it is generally measured as the employment or number of new firms (Delgado et al., 2010; Glaeser and Kerr, 2009) and entry rate which is defined as the

number of new firms over the number of incumbents (Klapper et al., 2010). However, there are various kinds of new firms in transitional China and they differ significantly in ownerships. Therefore, the study on Chinese entrepreneurship cannot only use new firm formation as a proxy of entrepreneurship. Specifically, objective and motivation of establishing new firms differs across firm ownerships. Newly established foreign-owned firms, whose location choice is dependent on the international strategy of parent firms, are not real entrepreneurship. Newly established state-owned firms are mainly driven by national strategy or local governments rather than entrepreneurs. Newly established enterprise-owned firms should be also excluded since we focus on new firms that are independent from existing firms. Therefore, this study only uses privately owned start-ups to measure entrepreneurship. Most studies on Chinese entrepreneurship use individual or companies' survey data. Although survey data can cover some important information on entrepreneurial traits, their sample size is often very limited. Though ASIFs has many advantages, we cannot ignore its obvious weakness that it does not cover non-state-owned enterprises with sales revenues below 5 million Yuan. Following Glaeser and Kerr (2009) and Delgado et al. (2010), we measure the number of start-ups in their starting years as a proxy of entrepreneurship.

Pattern of manufacturing entrepreneurship in China

With the deepening reform of state-owned enterprises and development of a market economy in China, the percentage of state-owned start-ups in employment and number have decreased by 69.7% and 91.3%, respectively, during 2001–2007 (Table 1), while those of privately owned start-ups have increased by 63.2% and 45.1%, respectively. These figures indicate that the influence of privately owned business on China's manufacturing economy has proliferated in the early 21st century, and the vitality of the economy has been unleashed.

Table 1. The employment and number of all start-ups and start-ups of different ownership, 2001–2007.

Year	Employees of start-ups	Private (%)	Foreign (%)	State (%)	Others (%)
2001	992,163	29.80	14.46	5.52	50.22
2002	583,465	32.83	20.68	2.96	43.53
2003	1,053,907	41.44	20.91	2.38	35.28
2004	1,850,418	42.68	27.83	1.16	28.33
2005	1,241,207	44.46	26.60	3.42	25.52
2006	1,174,155	45.17	31.89	0.77	22.17
2007	1,425,489	48.64	25.79	1.67	23.89
Year	No. of start-ups	Private (%)	Foreign (%)	State (%)	Others (%)
2001	4587	45.26	13.87	3.90	36.97
2002	3101	48.63	16.83	2.03	32.51
2003	6022	55.01	15.34	1.18	28.46
2004	12,665	58.41	18.05	0.83	22.72
2005	8981	59.82	15.86	0.57	23.76
2006	9186	65.30	16.12	0.36	18.22
2007	12,314	65.70	14.13	0.34	19.83

Sources: Annual Survey of Industrial Firms (ASIF).

For almost all industries except Manufacture of Chemical Fibres, Smelting and Pressing of Ferrous Metals and Manufacture of Tobacco,[1] the number of privately owned start-ups increases rapidly by 100% over the period 2001–2007 (Figure 1). There is substantial industrial variation in the magnitude and change of entrepreneurship. Taking the year 2007 as an example, the number of privately owned start-ups ranges from 17 for Manufacture of Chemical Fibres to 776 for Manufacture of Non-metallic Mineral Products. Most industries with a high level of entrepreneurship are those with low entry thresholds, such as Manufacture of Non-metallic Mineral Products, Manufacture of Textiles, Processing of Agricultural Products and so forth. During the years of 2001–2007, the fast-growing industries in entrepreneurship are not all labour-intensive or light industries. The entrepreneurship in Manufacture of Special Purpose Machinery, Manufacture of Rubber and Manufacture of General Purpose Machinery has also soared rapidly.

We apply the Gini coefficient to illustrate the spatial distribution of entrepreneurship and its change in China between 2001 and 2007. All Gini coefficients are greater than 0.6, indicating that entrepreneurship in China is spatially concentrated. During 2001–2007, there see a trend of increasing concentration of entrepreneurship (Figure 2). Specifically, the developed coastal regions and Chongqing, as the growth pole in the western regions, have observed a high level of entrepreneurship. Cities in Shandong province, the inland of Fujian province, the north of Liaoning province and the regions along the Yangtze River experience significant growing trend of entrepreneurship during the period. Shandong province is the fastest growing region of entrepreneurship, with 138 start-ups in 2001 and 2295 in 2007.

To further explore the relationship between agglomeration economies and entrepreneurship,[2] we overlay the spatial distribution of entrepreneurship with that of manufacturing density in 2007. Figure 3 shows that entrepreneurship seems higher in most cities with a high density of manufacturing, but there are some exceptions. Some cities in Heilongjiang province, the north of Hebei province, the south of Liaoning province, Henan province and the coastal area of Fujian see a high level of manufacturing agglomeration, but a low level of entrepreneurship. This may be related to regional industrial structure and the internal structure of agglomeration economies. The following section is to test the influence of agglomeration economies and its internal structure on entrepreneurship.

Model specification and variables

Dependent variables and model specification

The above descriptive analysis indicates that entrepreneurship varies across cities and sectors. This section will identify the model specification and measurement of variables in order to conduct a systematic analysis on the determinants of entrepreneurship. The dependent variable is defined as the number of privately owned start-ups at the three-digit manufacturing sector level and at the prefectural city level. The number of start-ups is a non-negative integer and the distribution of start-ups is generally skewed to the right. Moreover, it contains a large proportion of zeros. We therefore estimate a negative binomial model with a city-sector panel to deal with the right-censored problem and simultaneously control for the heterogeneity of cities and sectors. The city-sector fixed effect is employed instead of the city-year fixed effect because sectoral variation is much larger than temporal variation. We

Figure 1. The number of privately owned start-ups by two-digit manufacturing industries, 2001 and 2007.
Sources: Annual Survey of Industrial Firms (ASIF).

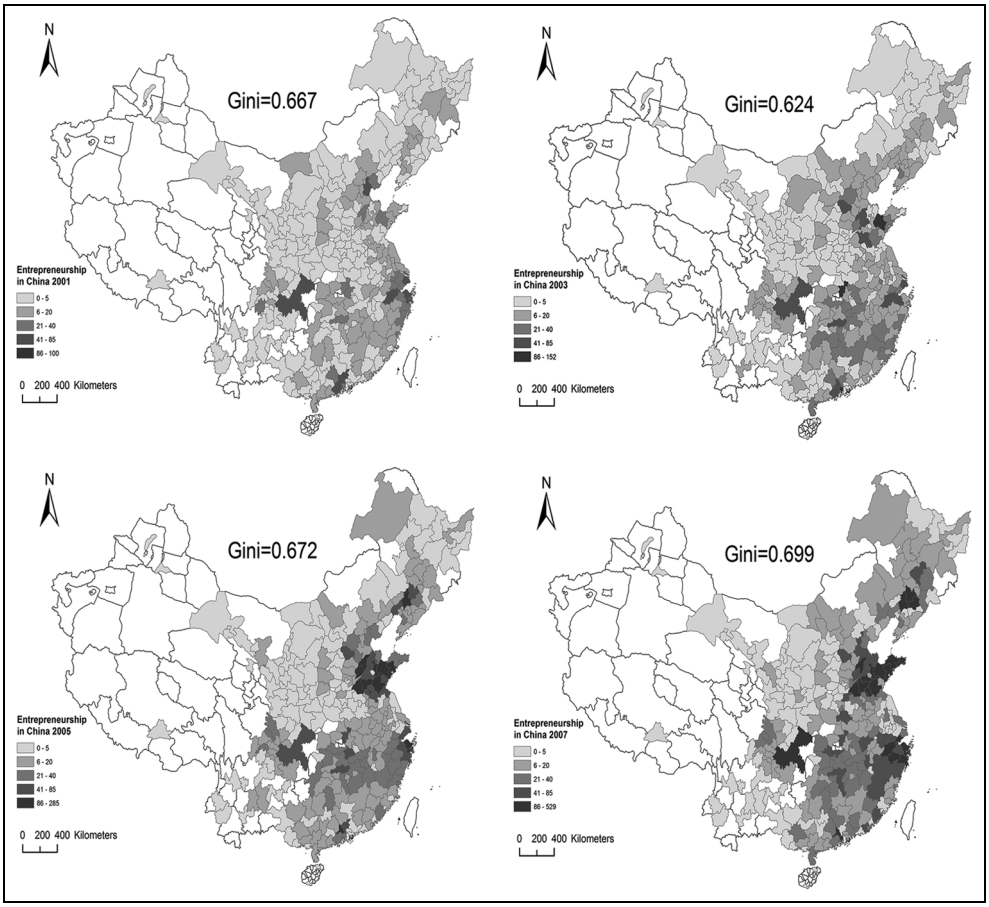

Figure 2. Spatial pattern of private-owned manufacturing start-ups, 2001, 2003, 2005 and 2007.
Sources: Annual Survey of Industrial Firms (ASIF).

would present the results in different years. The basic model (1) and one of extended models (2) are as follows.

$$\begin{aligned} \mathrm{P}(\mathrm{n}_{\mathrm{irt}}) = {} & \beta_{ot} + \beta_1 LOC_{irt-2} + \beta_2 D_{irt-2} \\ & + \beta_3 ENTRY_{irt-2} + \beta_4 GROWTH_{irt-2} \\ & + \beta_5 SUBSIDY_{irt-2} \\ & + \beta_6 \gamma_1 + \beta_7 \gamma_2 + \varepsilon_{irt} \end{aligned} \tag{1}$$

$$\begin{aligned} \mathrm{P}(\mathrm{n}_{\mathrm{irt}}) = {} & \beta_{ot} + \beta_1 SUPPLIER_{irt-2} \\ & + \beta_2 CUSTOMER_{irt-2} + \beta_3 R_{irt-2} \\ & + \beta_4 U_{irt-2} + \beta_5 ENTRY_{irt-2} \\ & + \beta_6 GROWTH_{irt-2} + \beta_7 SUBSIDY_{irt-2} \\ & + \beta_8 \gamma_1 + \beta_9 \gamma_2 + \varepsilon_{irt} \end{aligned} \tag{2}$$

where i, r, and t denote sector, city and time, respectively. All variables are aggregated ones at the city-sector level by using the data from ASIFs.

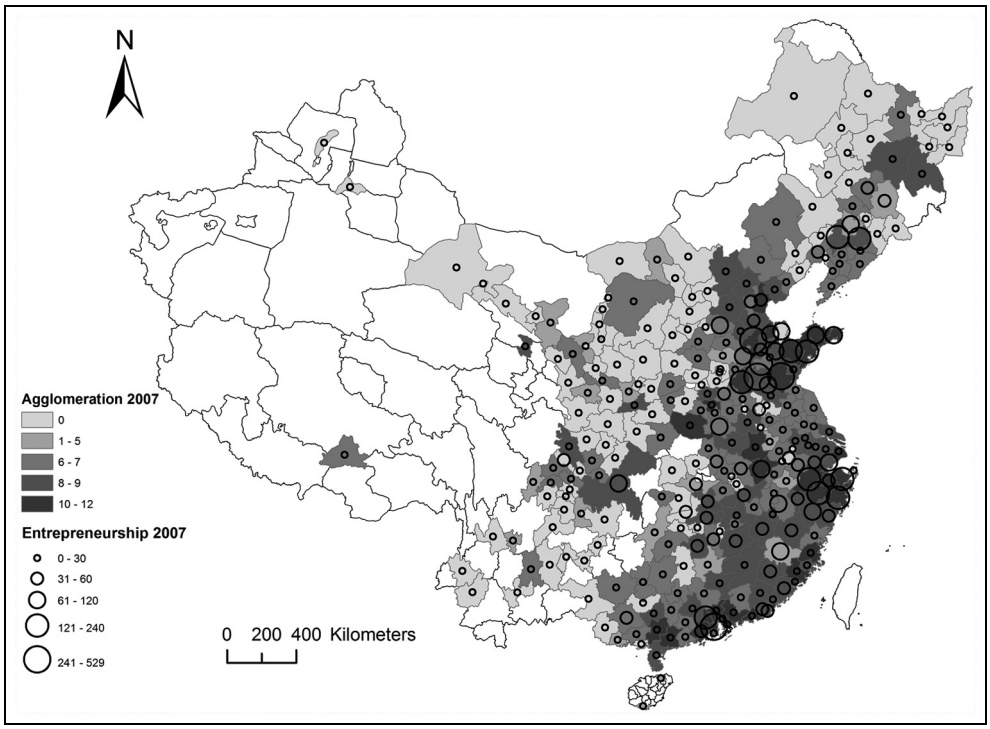

Figure 3. Spatial pattern of agglomeration and entrepreneurship in China, 2007.
Sources: Annual Survey of Industrial Firms (ASIF).

Independent variables

Localisation externalities and supplier/customer linkages. Following Delgado et al. (2010), we use the location quotient (LOC) of employment at the three-digit manufacturing sector level as a proxy of localisation economies. According to Marshall (1920) and Krugman (1991), supplier/customer linkages are the major source of localisation economies, so we introduce two variables, *SUPPLIER* and *CUSTOMER*, which are based on:

$$\mathrm{INPUT_{ri}} = \sum\nolimits_{k \in I} input_{i \leftarrow k} * Empl_{rk} \quad (3)$$

$$\mathrm{OUTPUT_{ri}} = \sum\nolimits_{k \in I} output_{i \rightarrow k} * Empl_{rk} \quad (4)$$

where $input_{i \leftarrow k}$ denotes the share of sector i's inputs that come from sector k and is also regarded as the weight, ranging from zero (no input from sector k) to one (full dependency on sector k); $Empl_{rk}$ stands for the employment in sector k in city r; i indexes sectors. $\mathrm{INPUT_{ri}}$ represents the potential input relations provided by city r for new firms in sector i. Similarly, $output_{i \rightarrow k}$ denotes the share of sector i's outputs that are purchased by sector k, ranging from zero (no output goes to sector k) to one (all outputs go to sector k); $\mathrm{OUTPUT_{ri}}$ is the potential customer linkage provided by city r for new firms in sector i. Then the location quotient of INPUT and OUTPUT is used to measure comparative advantages of supplier linkage (SUPPLIER) and customer linkage (CUSTOMER), respectively. China's 2002 input–output table with 122 sectors (National Bureau of Statistics, 2006) is used to compute $input_{i \leftarrow k}$ and $output_{i \rightarrow k}$ in the formula of *SUPPLIER* and *CUSTOMER*.

Jacobs externalities, related variety and unrelated variety. In the literature, subsectors that belong to the same sector are defined as related, otherwise, they are unrelated (Boschma and Iammarino, 2009; Frenken et al., 2007), but there may exist strong technological relatedness between subsectors that do not belong to the same sectors (Essletzbichler, 2013). The other approach to measure technological relatedness is to calculate similarity between sectors in the use of input factors (Dumais et al., 2002; Farjoun, 1994). As input mix reflects production technology, two sectors with highly similar input mixes mean a close 'technological distance' (Frenken et al., 2007).

Combining the above two methods, we measure technological relatedness between three-digit manufacturing sectors as follows. First, technological relatedness between sectors is captured the similarity between two sectors' input mixes based on China's 2002 input–output table with 122 sectors. Following Los (2000), the similarity is calculated using cosine distance, defined as the cosine between a pair of input coefficient vectors:

$$\omega_{ij} = \frac{\sum_k \alpha_{ik} * \alpha_{jk}}{\sqrt{(\sum_k \alpha_{ik}^2 * \sum_k \alpha_{jk}^2)}} \qquad (5)$$

where α_i and α_j are the pair of input coefficient vectors, and k denotes the k_{th} input. ω_{ij} would be closer to 1, if two sectors show higher technological relatedness. Following Los (2000), two sectors are defined as related if cosine distance between two sectors is over 0.4.

Second, each pair of three-digit sectors within the same two-digit sector is defined as related. Technological relatedness is a dummy variable in this study, 1 for related and 0 for unrelated. Therefore, we construct a matrix of technological relatedness among 162 three-digit sectors.

To break down Jacobs externalities, we use the total employment in all other manufacturing sectors except sector i (D) as a proxy of Jacobs externalities that sector i in city r faced with. Related variety (R) is measured by the employment in the sectors related technologically with sector i in city r, while unrelated variety (U) is measured by the employment in the sectors unrelated technologically with sector i in city r as follows.

$$R_{ir} = \sum_{j \in W, j \neq i} E_{jr} \; U_{ir} = \sum_{j \notin W, j \neq i} E_{jr} \qquad (6)$$

where W is a set of sectors technologically related with sector i. E_{jr} denotes the employment of sector j in city r. Hence, Jacobs externalities is the sum of R_{ir} and U_{ir}.

The Vernon-Chinitz effect. To test the Vernon-Chinitz effect, we break down the agglomeration variables (including LOC, SUPPLIER, CUSTOMER, D, R and U) using employments of small firms (fewer than 50 employees), medium-sized firms (51–200 employees) and large firms (>200 employees). The thresholds are higher than Rosenthal and Strange (2003, 2010). There are two reasons to adopt higher thresholds. One is that the manufacturing sector in China is more labour-intensive, leading to larger average size of firms; the other is that our classification makes every group account for about one-third of the total and the distribution is more even. As mentioned above, LOC are the location quotients as follows:

$$LOC = \frac{e_i/e}{E_i/E} \qquad (7)$$

where e_i is local employment in sector i; e is total local manufacturing employment; E_i is national employment in sector i; E is total national manufacturing employment. We

Table 2. Definition of independent variables.

Variable	Definition	Form	Measurement
LOC	Localisation	log	The location quotient of employment at the sector/city level
SUPPLIER	Suppliers	log	The sums of supply sectors' employment weighted by the proportions of supply sectors' inputs required by one sector at the city level
CUSTOMER	Customers	log	The sums of demand sectors' employment weighted by the share of one sector's output sales that go to demand sector at the city level
D	Diversification	log	The sums of employment of other manufacturing besides the sector itself at the city level
R	Related variety	log	The sums of employment of other related manufacturing at the sector/city level
U	Unrelated variety	log	The sums of employment of other unrelated manufacturing employment at the city level
_S	Subscript	log	The measurement calculated at small-sized firms
_M	Subscript	log	The measurement calculated at medium-sized firms
_L	Subscript	log	The measurement calculated at large-sized firms
ENTRY	Entry rate		The share of the number of new firms in all existing firms at the sector/city level
GROWTH	Growth Rate		The growth rates at year t are the difference between employment at year t and $t-1$, divided by employment at year t at the sector/city level
SUBSIDY	Subsidy rate		The ratio between the subsidies and gross output value at the sector/city level
γ_1			The sector fixed effect of panel models
γ_2			The city fixed effect of panel models

Notes: Zero value in some variables such as LOC, SUPPLIER and CUSTOMER were replaced with the minimum value of corresponding variables.

decompose e_i, local employment in sector i, into employments of small firms, medium-sized firms and large firms. SUPPLIER and CUSTOMER are decomposed in the same way.

When an entrepreneur decides to establish a new firm, local market prospects and the performance of incumbent firms are expected to affect the entrepreneur's choice of whether to enter the city and the sector. We further include the entry rate (ENTRY) and growth rate (GROWTH) at the three-digit sector at the city level in the model. In order to control the effect of industrial policies on entrepreneurship, we introduce the subsidy rate (SUBSIDY) as one of the control variables (Table 2). To solve the endogeity problem of the agglomeration and other variables, all independent variables were lagged by two years. Most independent variables were logarithmic. The definition and measurement of independent variables are summarised in Table 2.

Empirical results

We employ the city-sector fixed effect negative binomial model to estimate the impact of agglomeration economies, the Vernon-Chinitz effect, and the size effect of start-ups on the number of privately owned start-ups during 2001–2007. According to correlation analysis, the independent variables are not highly correlated (Appendix Table 1).

However, suppliers, customers, industrial diversity, related variety and unrelated variety at different sizes are strongly correlated (Appendix Table 2; Appendix Table 3), so we separately test their impacts on entrepreneurship. The results demonstrate that all models are significant and have strong explanatory power.

Impact of agglomeration economies

Statistical results about the effect of localisation economies and Jacobs externalities on entrepreneurship are presented in Table 3. The coefficients of LOC are positive and significant in all models, which is consistent with results of most studies (Combes et al., 2004; Glaeser et al., 2010; Henderson, 1997). The results indicate that the variation of entrepreneurship in China can be explained by localisation economies, much like the USA (Glaeser et al., 2010), but the effect magnitude in China is much smaller than 0.966 in the USA. There is still upside potential for the role of localisation economies in China.

Further, we replace LOC with SUPPLIER and CUSTOMER to test Hypothesis 2. The results show that both variables hold expected signs and are highly significant. Supplier/customer linkages have a significantly positive impact on entrepreneurship, indicating that industrial linkages are very important source of localisation economies. Access to suppliers and customers can help new firms reduce transportation costs and search costs. Moreover, the coefficients of SUPPLIER are significantly much larger than those of CUSTOMER. This is consistent with the findings of Glaeser and Kerr (2009) that the suppliers seem to be more important to supporting entrepreneurship than customers. For start-ups, search costs and production costs are crucial especially in the early stage. Proximity to a large number of suppliers not only help start-ups find suitable inputs quickly, but also lower the price of inputs because of fierce competition between local suppliers.

There is no evidence to support Hypothesis 3. The effect of industrial diversity is ambiguous since the coefficients of Jacobs externalities that occur in all years except 2005 are insignificant and the signs are not robust. Despite this, we still cannot deny the important role of industrial diversity. Local knowledge spillovers are more likely to occur among a large number of technologically related industries, rather than among a large diversity of unrelated industries. Therefore, we decompose industrial diversity into related variety and unrelated variety. As expected, related variety does have a significant and positive coefficient during 2001–2007, while the ambiguity of Jacobs externalities is mainly caused by unrelated variety. The finding provides empirical support for Hypothesis 4. Entrepreneurs in China can benefit from knowledge spillovers between technologically related industries. However, unrelated variety may lead to fierce competition for local input factors such as electricity and infrastructure facilities. Similar findings are reported in the studies of Frenken et al. (2007) and Boschma and Frenken (2011). The negative impact of unrelated variety may mitigate the positive externality of related variety. The statistical results on localisation economies, business linkages and related variety clearly suggest that localised business network is crucial to facilitate entrepreneurship in China. Agglomeration externalities have been found in liberalised and globalised industries and regions to promote innovation, growth and productivity (He and Pan, 2010; Ke, 2010; Pan and Zhang, 2002; Xu, 2009; Zhang et al., 2014). Our results provide additional evidence to support the effectiveness of agglomeration externalities in transitional China.

Table 3. The effect of agglomeration economies on entrepreneurship (hereafter, city-sector fixed effect negative binomial models).

Variables	2001	2001	2003	2003	2005	2005	2007	2007
LOC	0.350***		0.266***		0.275***		0.272***	
SUPPLIER		0.497***		0.447***		0.407***		0.309***
CUSTOMER		0.214***		0.158***		0.182***		0.189***
D	0.048		−0.019		−0.153***		0.032	
R		0.108***		0.105***		0.075***		0.090***
U		0.127**		0.040		−0.030		−0.086***
ENTRY	0.244	0.942***	0.574***	1.269***	0.505***	1.218***	0.378***	0.988***
GROWTH	−0.009	0.014	0.001	0.015	−0.001	0.010	0.010	0.053**
SUBSIDY	−30.525*	0.084	−6.931	0.712	−2.970	0.993	−9.473	14.192***
Constant	−1.825**	−4.412***	−0.982	−3.273***	1.051*	−1.843***	−1.421***	−3.560***
Observations	35,802	35,802	39,528	39,528	40,986	40,986	39,366	39,366
Number of city	221	221	244	244	253	253	243	243
Log Lik	−6024	−6024	−8695	−8695	−11,655	−11,655	−14,529	−14,529

Notes: ***, ** and * indicate the significance level at 1%, 5% and 10%, respectively.

The Vernon-Chinitz effect

To explore the Vernon-Chinitz effect on entrepreneurship, localisation economies (LOC), supplier/customer linkages (SUPPLIER and CUSTOMER), Jacobs externalities (*D*), related variety (*R*) and unrelated variety (*U*) are decomposed into the corresponding variables for small firms, medium-sized firms and large firms. Because of serious collinearity issues (Appendix Table 2; Appendix Table 3), we introduce them in the models separately.

Statistical results indicate that compared with the clustering of large firms, the clustering of small and medium-sized firms are more important to entrepreneurship (Table 4). It is consistent with the view of the Vernon-Chinitz effect. Because the coefficient of LOC_S and LOC_M is not much larger than that of LOC_L, we confirm the significant difference by performing the *T* test. That is, the cities with more small and medium-sized firms at the same sector provide a more favourable environment for entrepreneurship because small firms are more likely to share independent suppliers, which is considered as one of major sources of the Vernon-Chinitz effect (Chinitz, 1961). The results further show that the influence of small suppliers is indeed more important than that of medium-size and large suppliers. Similar results are also found in developed economies (Glaeser and Kerr, 2009). Moreover, access to small and independent customers is also critical to entrepreneurship because large customers who have the initiative in price negotiation will depress prices in a malicious manner, thus narrowing profit margins of start-ups (Bain, 1959; Scherer, 1970). Even though large customers play a less role on entrepreneurship than small ones do, access to them still help entrepreneurs start new businesses.

The results of the Vernon-Chinitz effect of Jacobs externalities are shown in Table 5. Related variety and unrelated variety have

Table 4. The Vernon-Chinitz effect of localisation economies.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LOC_S	0.118***						
LOC_M	0.176***						
LOC_L	0.104***						
SUPPLIER_S		1.580***					
SUPPLIER_M			0.302***				
SUPPLIER_L				0.125***			
CUSTOMER_S					1.244***		
CUSTOMER_M						0.575***	
CUSTOMER_L							0.149***
Observations	39,366	39,366	39,366	39,366	39,366	39,366	39,366
Number of city	243	243	243	243	243	243	243
Log Lik	−12,890	−14,715	−14,719	−14,695	−14,718	−14,691	−14,705

Notes:
1. SUPPLIER and CUSTOMER at different sizes are put in the model separately because of collinearity, controlling for D, ENTRY, GROWTH and SUBSIDY.
2. ***, ** and * indicate the significance level at 1%, 5% and 10%, respectively.

opposite effects on entrepreneurship, which can explain the insignificance of Jacobs externalities (Table 5). There are some variations in the roles of different types of related variety. The role of small and medium-sized firms within related variety is larger than that of large firms. It makes sense that large firms have higher motivation and capability to protect their knowledge and innovation from spilling over. Moreover, small related firms are more likely to foster potential entrepreneurs who are familiar with the related tasks and can deal with all kinds of issues on new firm formation (Johnson and Cathcart, 1979).

The size effect of start-ups

Jacobs (1969) argues that small firms benefit more from industrial agglomeration than large firms do because small firms are more dependent on external industrial environment. In order to examine the impact of agglomeration economies on start-ups of different size, we break down the dependent variable – the number of privately owned start-ups – into the number of small start-ups (fewer than 50 employees), medium-sized start-ups (51–200 employees), and large start-ups. Owing to serious colinearity between independent variables, we introduce all variables in the models separately but combine the estimated results together in Table 6.

Both small and medium-sized start-ups can benefit from different types of agglomeration economies, but the magnitude of coefficients is significantly different according to the *T* tests. Smaller start-ups are more dependent on the clustering of small and medium-sized firms. Small suppliers and small customers are the most important for small start-ups, which is consistent with the findings of Glaeser and Kerr (2009) that small suppliers have the largest effect on smaller entrants. In terms of Jacobs externalities, smaller related firms matter more to small start-ups than larger related firms do. Therefore, cities with more small firms (whether at the same sector, suppliers, customers or at the technologically related sectors) are more conducive to the birth of small firms, since small firms themselves lower the entry threshold through the

Table 5. The Vernon-Chinitz effect of Jacobs externalities.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
D_S	0.011								
D_M		−0.000							
D_L			0.043						
R_S				0.067***					
R_M					0.066***				
R_L						0.041***			
U_S							−0.074***		
U_M								−0.097***	
U_L									−0.059*
Observations	39,366	39,366	39,366	39,366	39,366	39,366	39,366	39,366	39,366
Number of city	243	243	243	243	243	243	243	243	243
Log Lik	−13,453	−13,453	−13,452	−13,422	−13,424	−13,436	−13,450	−13,448	−13,451
Prob > chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes:

1. *D*, *R* and *U* at different sizes are put in the model separately because of collinearity, controlling for variables such as LOC, ENTRY, GROWTH and SUBSIDY.
2. ***, ** and * indicate the significance level at 1%, 5% and 10%, respectively.

Table 6. The Vernon-Chinitz effect for start-ups with different sizes in 2007.

	Small	Medium	Large
LOC_S	0.167***	0.099***	0.034**
LOC_M	0.167***	0.192***	0.179***
LOC_L	0.083***	0.122***	0.191***
SUPPLIER_S	1.707***	1.468***	1.606
SUPPLIER_M	0.253**	0.339***	0.820***
SUPPLIER_L	0.131***	0.132***	0.135***
CUSTOMER_S	1.594***	0.634	−0.112
CUSTOMER_M	0.651***	0.541***	0.416**
CUSTOMER_L	0.178***	0.152***	0.079
R_S	0.096***	0.055***	−0.004
R_M	0.074***	0.071***	0.005
R_L	0.044***	0.048***	0.003

Note: ***, ** and * indicate the significance level at 1%, 5% and 10%, respectively.

development of independent suppliers, venture capitalists, entrepreneurial culture.

Medium-sized start-ups are more likely to locate with medium-sized firm clusters. Though large start-ups are positively attracted by the clusters of small and medium-sized firms, they are most inclined to cluster with large firms. Compared with small and medium-sized start-ups, large start-ups may not care about where small suppliers, customers and related firms are located. That is, their location choice is more independent since most of them can source internally and thus are less dependent on external environment.

Robustness check

To check the robustness of the above results, we replace the number of privately owned start-ups with the employment of privately owned start-ups as dependent variables. Owing to an excess of zero values, we estimate panel Tobit models and carry out the similar procedure mentioned above. The results hold for all models, so we do not show the estimated results here to save space.

Conclusion and implications

Agglomeration is not as simple as it seems. Its internal structure determines its effectiveness. Localisation and urbanisation economies are traditional and rough classification of agglomeration economies, which is insufficient to explain the complex economic structure. This study introduces the supplier/customer linkages, related variety and the Vernon-Chinitz effect in order to shed light on the internal structure of agglomeration economies. The supplier/customer linkages refer to production networks within clusters, and related variety stresses knowledge spillovers. The Vernon-Chinitz effect emphasises essentially the sharing of production and information networks among small firms. The business network and sharing are the essence of agglomeration economies.

This paper answers the question why some regions are more entrepreneurial than others in China by stressing the importance of agglomeration economies. As we expect, localisation economies predict entrepreneurship well, but the effect of Jacobs externalities is mixed. In terms of localisation economies, supplier/customer linkages play a very important and positive role in shaping

entrepreneurship. The mixed results of Jacobs externalities are mainly derived from the interweaving of related variety and unrelated variety. Related variety is conducive to entrepreneurship significantly, while unrelated variety in most cases discourages entrepreneurship. Traditional understanding of agglomeration economies highlights the role of size and density, but our findings reveal the critical role of technological relatedness and internal structure of agglomeration in facilitating entrepreneurship.

The clustering of small and medium-sized firms has a larger effect on entrepreneurship than the clustering of large firms does. These results are very much in the spirit of Vernon (1960) and Chinitz (1961). The estimated results on the clustering of small suppliers and small related firms provide more support for the Vernon-Chinitz effect. In addition, the above effects vary across start-ups of different sizes.

This study is among the first to explore the impact of the internal structure of agglomeration economies on entrepreneurship in China. Because of data limitations, however, our sample does not cover non-state-owned enterprises with sales revenues below five million Yuan. There may be estimated bias. The average size of manufacturing firms is generally larger because of increasing returns to scale, so the estimated bias may be very small even if there were.

Even though economic reform unleashes the vitality of the market in China, decentralisation endows local governments with more power to intervene in local development. To improve local achievements as soon as possible or compete with neighbouring areas, local governments prefer to attract foreign direct investment or big domestic enterprises via various preferential policies, rather than small firms. Once the foreign firms or large enterprises as the supports of the urban economy failed or relocated, the city would be faced with the risk of economic recession. Besides, local governments are engaged in establishing industrial parks, in which entering industries may be not technically related with each other or not linked with each other in terms of production. Our results suggest that clustering of small firms, related firms and supplier/customer linkage can help construct a favourable environment for manufacturing entrepreneurship in China. Localised business networks are key for entrepreneurship. Therefore, local governments and financial institutions should pay more attention to the development of small firm clusters and provide them with more favourable policies and financial supports.

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Notes

1. Manufacture of Tobacco is fully constrained industries in China, so we exclude it from this study.
2. Agglomeration here is measured by the number of all existing manufacturing firms in 2007.

References

Acs ZJ and Armington C (2006) *Entrepreneurship, Geography, and American Economic Growth*. New York, NY: Cambridge University Press.

Armington C and Acs ZJ (2002) The determinants of regional variation in new firm formation. *Regional Studies* 36(1): 33–45.

Bain JS (1959) *Industrial Organization*. New York: John Wiley & Sons.

Bates T (1990) Entrepreneur human capital inputs and small business longevity. *The Review of Economics and Statistics* 72(4): 551–559.

Boschma A and Weterings BR (2007) The spatial evolution of the British automobile industry: Does location matter? *Industry and Corporate Change* 16(2): 213–238.

Boschma R (2005) Proximity and innovation: a critical assessment. *Regional studies* 39(1): 61–74.

Boschma RA and Frenken K (2006) Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography* 6(3): 273–302.

Boschma R and Frenken K (2011) Technological relatedness, related variety and economic geography. In: Cooke P (ed.) *Handbook of Regional Innovation and Growth*. Cheltenham: Edward Elgar, pp. 187–197.

Boschma R and Iammarino S (2009) Related variety, trade linkages, and regional growth in Italy. *Economic Geography* 85(3): 289–311.

Chen J (2012) The small firm effect and the quality of entrepreneurs. Working paper, Copenhagen Business School.

Chinitz B (1961) Contrasts in agglomeration: New York and Pittsburgh. *American Economic Review: Papers and Proceedings* 51(2): 279–89.

Combes P-P, Magnac T and Robin J-M (2004) The dynamics of local employment in France. *Journal of Urban Economics* 56(2): 217–243.

Cooper AC and Folta TB (2000) Entrepreneurship and high technology clusters. In: Sexton DL and Landstrom H (eds) *Handbook of Entrepreneurship*. Oxford: Blackwell, pp. 348–367.

Delfmann H, Koster S, McCann P, et al. (2014) Population change and new firm formation in urban and rural regions. *Regional Studies* 48(6): 1034–1050.

Delgado M, Porter ME and Stern S (2010) Clusters and entrepreneurship. *Journal of Economic Geography* 10(4): 495–518.

Djankov S, LaPorta R, Lopez-de-Silanes F, et al. (2002) The regulation of entry. *Quarterly Journal of Economics* 117(1): 1–37.

Dobrev SD and Barnett WP (2005) Organizational roles and transition to entrepreneurship. *Academy of Management Journal* 48(3): 433–449.

Dumais G, Ellison G and Glaeser EL (2002) Geographic concentration as a dynamic process. *Review of Economics and Statistics* 84(2): 193–204.

Duranton G and Puga D (2001) Nursery cities: Urban diversity, process innovation, and the life cycle of products. *American Economic Review* 91(5): 1454–1477.

Elert N (2014) What determines entry? Evidence from Sweden. *The Annals of Regional Science* 53(1): 55–92.

Essletzbichler J (2013) Relatedness, industrial branching and technological cohesion in US metropolitan areas. *Regional Studies* 49(5): 752–766.

Farjoun M (1994) Beyond industry boundaries: Human expertise, diversification and resource-related industry groups. *Organization Science* 5(2): 185–199.

Feldman MP (2001) The entrepreneurial event revisited: An examination of new firm formation in the regional context. *Industrial and Corporate Change* 10(4): 861–891.

Feldman M, Francis J and Bercovitz J (2005) Creating a cluster while building a firm: Entrepreneurs and the formation of industrial clusters. *Regional Studies* 39(1): 129–141.

Frenken K, Van Oort F and Verburg T (2007) Related variety, unrelated variety and regional economic growth. *Regional Studies* 41(5): 685–697.

Ghani E, Kerr WR and O'Connell S (2013) Spatial determinants of entrepreneurship in India. *Regional Studies* 48(6): 1071–1089.

Glaeser EL and Kerr WR (2009) Local industrial conditions and entrepreneurship: How much of the spatial distribution can we explain? *Journal of Economics and Management Strategy* 18(3): 623–663.

Glaeser EL, Kallal HD, Scheinkman JA, et al. (1992) Growth in cities. *Journal of Political Economy* 100(6): 1126–1152.

Glaeser EL, Kerr WR and Ponzetto GAM (2010) Clusters of entrepreneurship. *Journal of Urban Economics* 67(1): 150–168.

Gompers P, Lerner J and Scharfstein D (2005) Entrepreneurial spawning: Public corporations and the genesis of new ventures, 1986 to 1999. *The Journal of Finance* 60(2): 577–614.

He C, Wei Y D and Xie X (2008) Globalization, institutional change, and industrial location: Economic transition and industrial concentration in China. *Regional Studies* 42(7): 923–945.

He C and Pan F (2010) Economic transition, dynamic externalities and city industry growth in China. *Urban Studies* 47(1): 121–144.

Henderson V (1997) Externalities and industrial development. *Journal of Urban Economics* 42(3): 449–470.

Henderson V (2003) Marshall's scale economies. *Journal of Urban Economics* 53(1): 1–28.

Jacobs J (1969) *The Economy of Cities*. New York: Vintage Books.

Johnson PS and Cathcart DG (1979) The founders of new manufacturing firms: A note on the size of incubator plants. *Journal of Industrial Economics* 28(2): 219–224.

Ke S (2010) Agglomeration productivity and spatial spillovers across Chinese cities. *The Annals of Regional Science* 45(1): 157–179.

Klapper L, Amit R and Guillén MF (2010) Entrepreneurship and firm formation across countries. In: Lerner J and Schoar A (eds) *International Differences in Entrepreneurship*. Chicago, IL: University of Chicago Press, pp. 129–158.

Krugman P (1991) Increasing returns and economic geography. *Journal of Political Economy* 99(3): 483–499.

Los B (2000) The empirical performance of a new interindustry technology spillover measure. In: Saviotti P and Nooteboom B (eds) *Technology and Knowledge: From the Firm to Innovation Systems*. Cheltenham: Edward Elgar, pp. 118–151.

Malmberg A and Maskell P (2002) The elusive concept of localization economies: Towards a knowledge-based theory of spatial clustering. *Environment and Planning A* 34(3): 429–449.

Marshall A (1920) *Principles of Economics*. London: MacMillan.

Michelacci C and Silva O (2007) Why so many local entrepreneurs? *Review of Economics and Statistics* 89(4): 615–633.

Moomaw RL (1988) Agglomeration economies: Localization or urbanization? *Urban Studies* 25(2): 150–161.

National Bureau of Statistics (2006) *2002 Input–Output Table of China*. Beijing: China Statistics Press.

Neffke F, Henning M and Boschma R (2012) The impact of aging and technological relatedness on agglomeration externalities: A survival analysis. *Journal of Economic Geography* 12(2): 485–517.

Nelson RR and Winter SG (1982) The Schumpeterian tradeoff revisited. *The American Economic Review:* 114–132.

Nooteboom B (2000) *Learning and Innovation in Organizations and Economies*. Oxford University Press: Oxford.

Pan Z and Zhang F (2002) Urban productivity in China. *Urban Studies* 39(12): 2267–2281.

Parker SC (2009) Why do small firms produce the entrepreneurs? *The Journal of Socio-Economics* 38(3): 484–494.

Piore MJ and Sabel CF (1984) *The Second Industrial Divide: Possibilities for Prosperity*. New York: Basic Books.

Porter ME (1990) The competitive advantage of nations. *Harvard Business Review* 68(2): 73–93.

Porter ME (1998a) *Clusters and Competition: New Agendas for Companies, Governments, and Institutions*. Boston, MA: Harvard Business School Press.

Porter ME (1998b) *Competing Across Locations: Enhancing Competitive Advantage Through a Global Strategy*. Boston, MA: Harvard Business School.

Qian H and Haynes KE (2014) Beyond innovation: The Small Business Innovation Research program as entrepreneurship policy. *The Journal of Technology Transfer* 39(4): 524–543.

Reynolds P, Storey DJ and Westhead P (1994) Cross-national comparisons of the variation in new firm formation rates. *Regional Studies* 28(4): 443–456.

Romero-Martínez AM and Montoro-SánchezÁ (2008) How clusters can encourage entrepreneurship and venture creation. Reasons and advantages. *International Entrepreneurship and Management Journal* 4(3): 315–329.

Rosenthal SS and Strange WC (2003) Geography, industrial organization, and agglomeration. *Review of Economics and Statistics* 85(2): 377–393.

Rosenthal SS and Strange WC (2004) Evidence on the nature and sources of agglomeration economies. *Handbook of Regional and Urban Economics* 4: 2119–2171.

Rosenthal SS and Strange WC (2010) Small establishments/big effects: Agglomeration, industrial organization and entrepreneurship. In: Glaeser EL (ed.) *Agglomeration Economics*.

Chicago, IL: University of Chicago Press, pp.277–302.

Santarelli E and Sterlacchini A (1994) New firm formation in Italian industry: 1985–89. *Small Business Economics* 6(2): 95–106.

Saxenian A (1994) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge, MA: Harvard University.

Scherer FM (1970) *Industrial Market Structure and Economic Performance*. Chicago, IL: Rand McNally.

Stam E (2007) Why butterflies don't leave. Locational behavior of entrepreneurial firms. *Economic Geography* 83(1): 27–50.

Stam E (2010) Entrepreneurship, evolution and geography. In: Boschma R and Martin R (eds) *The Handbook of Evolutionary Economic Geography*. Cheltenham: Edward Elgar, pp. 307–348.

Stinchcombe AL (1965) Organizations and social structure. *Handbook of Organizations* 44(2): 142–193.

Stuart C (1979) Search and the spatial organization of trading. In: Lippman S and J McCall (eds) *Studies in the Economics of Search*. Amsterdam: North-Holland, pp. 17–34.

Stuart TE and Ding WW (2006) When do scientists become entrepreneurs? The social structural antecedents of commercial activity in the academic life sciences. *American Journal of Sociology* 112(1): 97–144.

Van Stel A and Suddle K (2008) The impact of new firm formation on regional development in the Netherlands. *Small Business Economics* 30(1): 31–47.

Vernon R (1960) *Metropolis 1985*. Cambridge, MA: Harvard University Press.

Viladecans-Marsal E (2004) Agglomeration economies and industrial location: City-level evidence. *Journal of Economic Geography* 4(5): 565–582.

Xu Zelai (2009) Productivity and agglomeration economies in Chinese cities. *Comparative Economic Studies* 51(3): 284–301.

Zhang P, He C and Sun Y (2014) Agglomeration economies and firm R&D efforts: An analysis of China's electronics and telecommunications industries. *The Annals of Regional Science* 53(3): 671–701.

Appendix Table 1. Correlation coefficients of independent variables in Table 3.

	LOC	SUPPLIER	CUSTOMER	D	R	U	ENTRY	GROWTH	SUBSIDY
LOC	1.000								
SUPPLIER	0.205	1.000							
CUSTOMER	0.119	0.354	1.000						
D	0.331	0.529	0.321	1.000					
R	0.339	0.346	0.351	0.514	1.000				
U	0.314	0.502	0.298	0.993	0.453	1.000			
ENTRY	0.185	0.045	0.031	0.042	0.054	0.040	1.000		
GROWTH	−0.013	−0.007	−0.007	−0.010	−0.013	−0.008	0.006	1.000	
SUBSIDY	0.022	0.002	0.000	0.003	0.005	0.002	0.000	−0.004	1.000

Appendix Table 2. Correlation coefficients of independent variables in Table 4.

	LOC_S	LOC_M	LOC_L	SUPPLIER_S	SUPPLIER_M	SUPPLIER_L	CUSTOMER_S	CUSTOMER_M	CUSTOMER_L
LOC_S	1.000								
LOC_M	0.479	1.000							
LOC_L	0.349	0.457	1.000						
SUPPLIER_S	0.188	0.155	0.051	1.000					
SUPPLIER_M	0.150	0.159	0.068	0.654	1.000				
SUPPLIER_L	0.035	0.060	0.082	0.082	0.202	1.000			
CUSTOMER_S	0.113	0.065	−0.013	0.418	0.285	0.024	1.000		
CUSTOMER_M	0.104	0.088	0.004	0.311	0.338	0.030	0.637	1.000	
CUSTOMER_L	−0.032	−0.029	−0.017	−0.076	−0.096	0.050	0.144	0.310	1.000

Appendix Table 3. Correlation coefficients of independent variables in Table 5.

	D_S	D_M	D_L	R_S	R_M	R_L	U_S	U_M	U_L
D_S	1.000								
D_M	0.931	1.000							
D_L	0.793	0.906	1.000						
R_S	0.595	0.537	0.444	1.000					
R_M	0.529	0.538	0.472	0.802	1.000				
R_L	0.446	0.477	0.484	0.709	0.801	1.000			
U_S	0.989	0.919	0.780	0.521	0.471	0.393	1.000		
U_M	0.926	0.993	0.899	0.482	0.474	0.421	0.923	1.000	
U_L	0.789	0.899	0.991	0.398	0.421	0.419	0.783	0.902	1.000