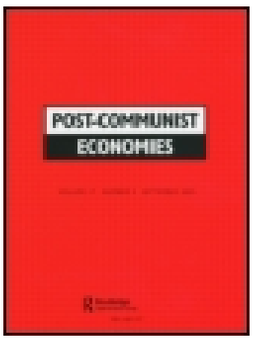

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Industry relatedness and new firm survival in China: do regional institutions and firm heterogeneity matter?

Qi Guo[a*], Shengjun Zhu[b] and Canfei He[b,c]

[a]College of Economic and Social Development, Nankai University, Tianjin, China; [b]College of Urban and Environmental Sciences, Peking University, Beijing, China; [c]Peking University-Lincoln Institute Center for Urban Development and Land Policy, Peking University, Beijing, China

ABSTRACT

Recent studies in evolutionary economic geography (EEG) highlight the key role of industry relatedness and cognitive proximity in boosting firm performance using data from developed countries. This paper explores the effect of industry relatedness on new firm survival in China by using a firm-level dataset for the 1999–2008 period. Based on survival models, it contributes to the ongoing debate by pointing out that new firms that are highly related to local industries have a lower failure rate, and the effect of industry relatedness is inflected by regional institutions and firm attributes. Industry relatedness occurs more effectively in the market-oriented regions but less effectively in regions with strong economic and political incentives of local governments.

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Evolutionary economic geography; industry relatedness; new firm survival; regional institutions; firm heterogeneity; China

1. Introduction

The dynamic process of firm birth, survival and failure is the manifestation of economic vitality and industrial restructuring, but excessive fluctuation may waste social and economic resources through firms' high failure rate. Understanding the causes underlying firm failure may not only help firms survive longer but also provide governments with policy suggestions on the creation of survival environments. Industrial organisation theory links survival to firm age, size, ownership, innovation activities, and industrial and market structure (Audretsch & Mahmood, 1995; Fontana & Nesta, 2009; Görg & Strobl, 2003). Researchers on economic geography and industrial ecology have shifted their focus to external factors that influence firm survival or firm failure, especially agglomeration economies (Acs, Armington, & Zhang, 2007; De Silva & McComb, 2012; He & Yang, 2016; Neffke, Henning, & Boschma, 2012).

Recent studies in evolutionary economic geography (EEG) challenge traditional findings on the mechanisms by which agglomeration externalities influence regional development and firm performance. In the literature on urban economics, agglomeration externalities are important factors that affect firm performance either through localisation economies based on specialised labour market pooling (*matching*), *sharing* intermediate inputs and

CONTACT Canfei He hecanfei@urban.pku.edu.cn
*Current address: Collaborative Innovation Center for China Economy, Nankai University, Tianjin, China.

local knowledge spillovers (*learning*) (Combes & Gobillon, 2015; Duranton & Puga, 2004; Marshall, 1898) or through Jacobs's externalities derived from the existence of a large variety of industries in the regional economy (Jacobs, 1969). Recent studies from the perspective of EEG argue that agglomeration externalities do not necessarily result in knowledge spillovers; instead, they occur effectively only when complementarities and industry relatedness exist among industrial sectors in terms of shared competences (Boschma & Iammarino, 2009; Boschma, Minondo, & Navarro, 2012, 2013; Frenken, Van Oort, & Verburg, 2007; Neffke, Henning, & Boschma, 2011). This perspective predicates on debates about the trade-off between diversity and similarity: although firms that possess non-overlapping competences and know-how can actually offer something new to be learned by others, only firms that overlap in competences to a certain extent may find it easier to communicate with each other (Neffke et al., 2011). In other words, for knowledge spillovers to enhance firm performance, there needs to be some sort of cognitive proximity, industry relatedness or complementarity between firms (Nooteboom, 2000). Industry relatedness is believed to play a critical role not only in regional economic development, employment and productivity growth (Boschma & Iammarino, 2009; Boschma et al., 2012; Boschma & Wenting, 2007; Frenken et al., 2007; Zhu, He, & Zhou, 2017) but also in increasing firms' survival rate or reducing the probability of firm failure (Basile, Pittiglio, & Reganati, 2017; Neffke et al., 2012).

This research thus seeks to contribute to the ongoing debate on industry relatedness and new firm survival with a new analytical perspective that emphasises the role of regional institutions and firm heterogeneity in China. First, the purpose of this study is to investigate the impact of industry relatedness on new firm survival in China. Unlike old firms, new firms are more dependent on the external environment due to lack of sufficient resources, production experience and bargaining power. However, new firms are often seen as the catalyst of regional innovation and vitality, so investigating the influencing factors of new firm survival and improving the survival chances of new firms is essential to promoting regional competitiveness.

Second, previous findings are based on relatively perfect market institutions in developed economies, but firms in developing economies may be faced with more complex market environments and institutional change, which may pose serious challenges to the existing theoretical and empirical findings. Many of these challenges are present in China, where the liberalisation and globalisation reform of markets have caused significant price fluctuations and market adjustment. Within this environment of uncertainty, firms seek to rely on knowledge spillovers and agglomeration externalities to secure profits and maintain competitive advantages (He & Pan, 2010). Furthermore, regional decentralisation has not only created GDP-based inter-jurisdictional competition between local authorities that have strong incentives to intervene in regional economic development (Pan, Zhang, Zhu, & Wójcik, 2016; Yu, Zhou, & Zhu, 2016) but also allowed regional administrations to take different routes, resulting in a geographically uneven economic and institutional landscape (Zhu & He, 2015). It remains unclear whether the role of industry relatedness in a transitional economy is different from what scholars have learned from the existing literature based mainly on developed countries with less state intervention and, more importantly, whether the relationship between industry relatedness and firm performance has changed because of China's geographically variegated institutional framework.

Third, firms in terms of survivability and reliance on external environment are heterogeneous, and the effect of industry relatedness and knowledge spillovers on firm survival may

vary across firm size, ownership and whether to be subsidised by governments, so this study also focuses on how firm heterogeneity affects the dependence of firm survival on industry relatedness. Therefore, this study examines new firm survival and specifically explores how industry relatedness and its interactions with regional institutions and firm heterogeneity affect Chinese firms' survival by employing a new and more precise measure of knowledge spillovers and industry relatedness (Boschma et al., 2013; Frenken et al., 2007), which is based on Hidalgo, Klinger, Barabasi, and Hausmann (2007)'s co-occurrence analysis. Based on a firm-level dataset of Chinese manufacturing industries during 1998–2008, the results show that firm survival is not only conditioned on industry relatedness and knowledge spillovers but also affected by the ways in which industry relatedness is interconnected with institutional contexts and firm heterogeneity.

The rest of the paper is structured in the following manner. Section 2 provides an extended discussion of the key literature on industry relatedness and firm survival, emphasising the impact of regional institutions and firm heterogeneity, and accordingly presents the research hypotheses. In Section 3, attention is then turned to data and patterns of new firm survival in China. Section 4 specifies the model and variables. Section 5 reports and analyses the empirical results. Section 6 concludes the main findings and discusses policy implications.

2. Literature review and research hypotheses

2.1. Industry relatedness and firm survival

Agglomeration externalities are broadly understood as the benefits that arise from the geographical co-location of economic agents. It has become common in the literature to separate the different kinds of external economies into those that are restricted within particular sectors of the economy – localisation externalities – and those that flow across sectors of the economy – urbanisation externalities. Recent extensions to the theoretical literature have raised questions on whether geographical proximity is the only form of proximity that impacts firm performance.

Since the important contribution of Boschma (2005), there has been an increasing awareness that cognitive proximity is more important than geographical proximity for information spillovers. Effective knowledge exchange and spillovers between firms in a locality occur when they are cognitively close, although some cognitive distance is still needed to avoid cognitive lock-in. The notion that an optimal level of cognitive distance may exist in knowledge spillovers and transfers predicates on Nooteboom's (2000) work, which claims that 'information is useless if it is not new, but it is also useless if it is so new that it cannot be understood' (p. 153). Hence, recent EEG studies have suggested that firms are more likely to learn from each other when they are technologically related and operate in related industries that have cognitive proximity (Boschma & Frenken, 2011). Knowledge spillovers, localised business linkages and labour mobility with similar skills are more likely to occur within regions hosting a large number of technologically related industries (Boschma & Frenken, 2006; Boschma et al., 2012; Boschma & Wenting, 2007; Essletzbichler, 2015). Industry relatedness thus plays a critical role not only in new firm formation and firm innovation (Boschma & Frenken, 2006; Boschma et al., 2012; Boschma & Wenting, 2007; Essletzbichler, 2015; Guo, He, & Li 2016) but also in firm survival and firm failure (Basile et al., 2017; Howell, He, Yang, & Fan, 2016; Neffke et al., 2012).

Based on conventional agglomeration externalities theory, a few studies have explored the link between agglomeration externalities and firm survival, but the empirical evidence is at best inconclusive. Some studies find that industrial agglomeration helps firm survival (Delgado, Porter, & Stern, 2010; He & Yang, 2016; Wennberg & Lindqvist, 2010), while others conclude that industrial clustering is associated with higher firm mortality (De Silva & McComb, 2012). One of the reasons why this is the case is that the role of the 'optimal cognitive distance' and industry relatedness between firms has largely been overlooked (Neffke et al., 2011). More recent studies have increasingly focused on industry relatedness as a key explanatory factor of firm survival and reached a quite consistent conclusion that industry relatedness is important to stimulate productive interactions and cross-fertilisations between firms in a region and thus lower firm failure rates (Basile et al., 2017; Boschma & Wenting, 2007; Neffke et al., 2012). Howell et al. (2016) find that related variety directly improves the chances of new firm survival in China, but they do not examine the possible nonlinear relationship between industry relatedness and firm survival. Therefore, this leads to the following hypothesis:

Hypothesis 1: firms that are highly related to local industries are less likely to fail in the context of post-reform China, and there may be an optimal cognitive distance.

2.2. Industry relatedness and regional institutions

In the recent industry relatedness literature, the significant impact of industry relatedness has been proven in developed countries with relatively perfect market institutions. However, transitional economies such as China have carried out political and economic reform, resulting in enormous spatial variations of the economic and institutional landscape (Wei, 2001). The underestimation of regional variations in the institutional environment may have a direct impact on understanding the intensity and nature of the knowledge spillover process (Boschma & Capone, 2016).

Since the late 1970s, China has embarked on the path to economic reform and opening up to the world in pursuit of economic development. A fundamental institutional change is a process of marketisation, including the liberalisation of prices, markets, investments and trade, and the privatisation of selected state-owned sectors. With the presence of markets and market-oriented institutions, firms can survive longer by depending on labour mobility, backward and forward business linkages, knowledge spillovers and especially industry relatedness, which can reduce firms' production costs and improve their efficiency.

However, economic liberalisation is regionally unbalanced in China (Han & Pannell, 1999). Some cities are more economically liberalised, with strong market forces at work, while others are still dominated by state-owned enterprises. Industry relatedness clearly demands that market-oriented institutions work more effectively. Some recent studies have reported a strong presence of inter-plant business linkages and business networks in economically liberalised regions (Zhu & He, 2015). To sum up, ideas developed in this section lead to the following hypothesis:

Hypothesis 2: The firms located in more market-oriented regions are more dependent on industry relatedness.

In addition, economic reform has also pushed forward a process of decentralisation, in which sub-national governments are authorised to have more rights and responsibilities to run

the local economy, while a higher proportion of tax revenue is allocated to the central government. Meanwhile, in the process of political centralisation, local economic performance has been used as an important assessment index of official selection by high-level officials in the hierarchical political system. Economic decentralisation with political centralisation has triggered intensive inter-jurisdictional competition in fiscal revenues and economic growth. The literature has either considered local officials as revenue maximisers (Oi, 1992) or stated that local officials seek to maximise their chances of political promotion (Li & Zhou, 2005). Both views agree that local authorities favour pro-business policies that take advantage of local resources or public financing to attract new enterprises and boost local businesses in China.

Local governments with lower revenues have a greater incentive to help firms survive through pro-business policies, including providing low-cost land and subsidies, reducing or remitting taxes, and inspiring local banks to offer soft loans and so on. In order to stimulate economic growth in the short term, governments may ignore the importance of industry relatedness for the promotion of the long-term competitiveness of firms and cities and instead support firms that are technologically unrelated to local production capabilities. However, preferential policies are not dateless; they usually last for between three and five years. The favoured firms may be more likely to fail due to over-reliance on pro-business policies once the policies expire. In addition, firms that cannot gain preferential policies also have higher rates of failure in the face of such an unfairly competitive environment. Therefore, this leads to the following hypothesis:

Hypothesis 3: Firms in regions with stronger economic and political incentives by local governments are more independent of industry relatedness.

2.3. Industry relatedness and firm heterogeneity

The notion of industry relatedness has assumed a renewed vision of the impact of agglomeration externalities on firm survival. However, not all firms are equally motivated by and/or capable of benefitting from industry relatedness and knowledge spillovers. For instance, large firms are more capable of survival on their own and thus may depend less on industry relatedness and knowledge spillovers than small- and medium-sized enterprises (SMEs). Moreover, firms differ from one another in terms of firm ownership in post-reform China (Bai, Lu, & Tao, 2009). State-owned enterprises (SOEs) may be less motivated to benefit from industry relatedness since they enjoy institutional advantages such as preferential access to favourable policies, business information and government subsidies (Lu, 2010). In contrast, foreign-owned enterprises (FOEs) are more likely to rely on agglomeration externalities since they suffer from serious information asymmetry and business uncertainties in China (He, 2002). Privately owned enterprises (POEs) enjoy independent decision-making power. They are fully responsible for their own business operations and more actively pursue cost minimisation and/or profit maximisation. They also face institutional uncertainties and challenges. POEs have strong incentives to exploit industry relatedness (Fan & Scott, 2003; He, Wei, & Xie, 2008). In addition, direct subsidies offered by governments to certain firms may spoil these firms and discourage them from innovating. If a firm receives a large amount of government subsidies, they may be increasingly dependent on government supports and become less incentivised to take advantage of industry relatedness and knowledge spillovers. To sum up, ideas developed in this section lead to the following hypothesis:

Hypothesis 4: The impact of industry relatedness on firm survival varies across firm heterogeneity.

3. Data and new firm survival

This study is based on data from the Annual Survey of Industrial Firms (ASIF), which is maintained by the State Statistical Bureau in China. It covers the period from 1999 to 2008. The dataset includes all SOEs and non-SOEs with sales revenues greater than RMB 5 million yuan. The dataset allows firms to be linked over time and provides useful information on firms' birth years, location, employment, exports and intermediate inputs. A comparison with the 2004 full census of industrial firms reveals that these firms in the dataset generated 90% of output, 93% of total sales revenues and 98% of exports in China.

3.1. Dependent variable: measuring new firm survival

The objective of this study is to test whether industry relatedness helps new firms survive in China. What needs to be measured is the survival opportunity of newly created firms for different years. The information on a firm's starting year is included in ASIF. This study compiles a list of firms that were established in each of the years from 1999 to 2007 and track information on their existence in subsequent years up to 2008. Assuming $firm_{it}$ is a new firm established in year t, which can be identified in the dataset in year $t+c$ but not after the year $t+c$, then $firm_{it}$ is defined as failing in the year $t+c$, and c is regarded as the duration of $firm_{it}$. What this study actually examines is not firm exit but firm failure – a firm that is able to meet the threshold in year t but fails to do so in year $t+1$. Howell et al. (2016) provide reasonable explanations for why the dataset can be used to examine new firm survival. On one hand, the minimum sales threshold of 'RMB 5 million yuan' is not strictly enforced in the dataset, which still includes 5% of privately owned firms below the threshold. On the other hand, new IDs are assigned to firms that undergo restructuring, mergers or acquisitions; 95.9% of all year-to-year matches are constructed using firm IDs and 4.1% using other information on the firm, including county code, telephone number and starting year. The matching method used in this study is that used by He and Yang (2016).

3.2. Spatial pattern of new firm survival in China

To examine the industrial and spatial variations in firm survival, this study estimates a survival function $S(t)$ using the Kaplan and Meier (1958) estimator, a frequently used non-parametric estimator that accounts for right censoring or truncation in time-series data – in our case, when the year of firm failure occurs after the last year of this study period. The Kaplan–Meier estimator is a good choice for exploratory analysis because of its non-parametric form. The estimator is given by

$$\widehat{S(t)} = \prod_{t_i \leq T} (1 - \frac{d_i}{n_i})$$

where $S(t)$ is the survivor function, yn_i denotes the number of firms in the risk set at time t_i, while d_i denotes the number of exits at t_i. Table 1 presents the results of the survival rate and the Kaplan–Meier estimator for all Chinese manufacturing firms during 1998–2008. It should

Table 1. Life table analysis for China's manufacturing industries.

Time	No. of observations	No. of exits	Exit rate	Survival rate	Kaplan–Meier estimator	Hazard rate
I	n_i	d_i	d_i/n_i	$1-d_i/n_i$	$\prod_{t_i \leq T}(1-\frac{d_i}{n_i})$	$2(d_i/n_i)/(2-d_i/n_i)$
[1–2]	46,276	4576	0.0989	0.9011	0.9011	0.1040
[2–3]	41,262	2991	0.0725	0.9275	0.8358	0.0752
[3–4]	29,946	2023	0.0676	0.9324	0.7793	0.0699
[4–5]	20,238	959	0.0474	0.9526	0.7424	0.0485
[5–6]	10,470	572	0.0546	0.9454	0.7017	0.0562
[6–7]	6070	309	0.0509	0.9491	0.6659	0.0522
[7–8]	4015	145	0.0361	0.9639	0.6415	0.0368
[8–9]	1642	54	0.0329	0.9671	0.6204	0.0334
[9–10]	807	0	0.0000	1.0000	0.6204	0.0000

be stressed that since we have pooled nine consecutive cohorts of firms entering in 1999–2007, the intervals presented in Table 1 do not coincide with calendar years but rather correspond to nine distinct exit or failure times. The Kaplan–Meier estimator is always lower than the survival rate, as the former measures the cumulative survival rate. Hazard rates start as high as 10.40% in the first interval, decline to 4.85% in the fourth interval, reach a lower peak in the fifth interval (5.62%) and drop to 3.34% in the ninth interval. In the last interval, hazard rates fall to 0.00% because all 807 firms, which were established in 1999 and maintained their business for nine years, managed to survive for one more year. The overall pattern for Chinese manufacturing firms shows a tendency (though non-monotonic) toward reduced hazard as firms age. In the last interval, the Kaplan–Meier estimator is 62.04%. The value of the 10-year Kaplan–Meier estimator is similar to the value of the 10-year Kaplan–Meier estimator calculated by Litzel (2017) based on the firm-level data in Bavaria, Germany (KM = 57.4%) but much higher than that calculated by Audretsch (1991) based on the US Small Business Database (KM = 35.4%), possibly because that dataset mainly covers small businesses.

Figure 1 shows spatial variations in the survival rates of new firms over one year, three years, five years and seven years at the prefectural city level. The divide between coastal and inland cities in firm survival is evident, with higher firm survival rates in coastal cities. This finding echoes with recent studies that have shown that after the reform, China's manufacturing industries became increasingly concentrated in the coastal region until the late 2000s and early 2010s, when a reverse and diffusive industrial relocation emerged and industries began to relocate from Eastern to Central and Western China (He et al., 2008; Zhu & He, 2015). Exploration of the data at a finer level of spatial aggregation suggests that entry rates also vary across cities within the same province, which suggests that local factors may play an important role in determining firm survival.

4. Model specification and variables

4.1. Model specification

To examine the effect of industry relatedness on firm survival, this study estimates the semi-parametric Cox proportional hazard model, which defines hazard rates as the probability that a firm fails in the market at a certain time t conditional on its survival to that time and on a set of covariates X_{it}. Survival analysis methods are appropriate to handle

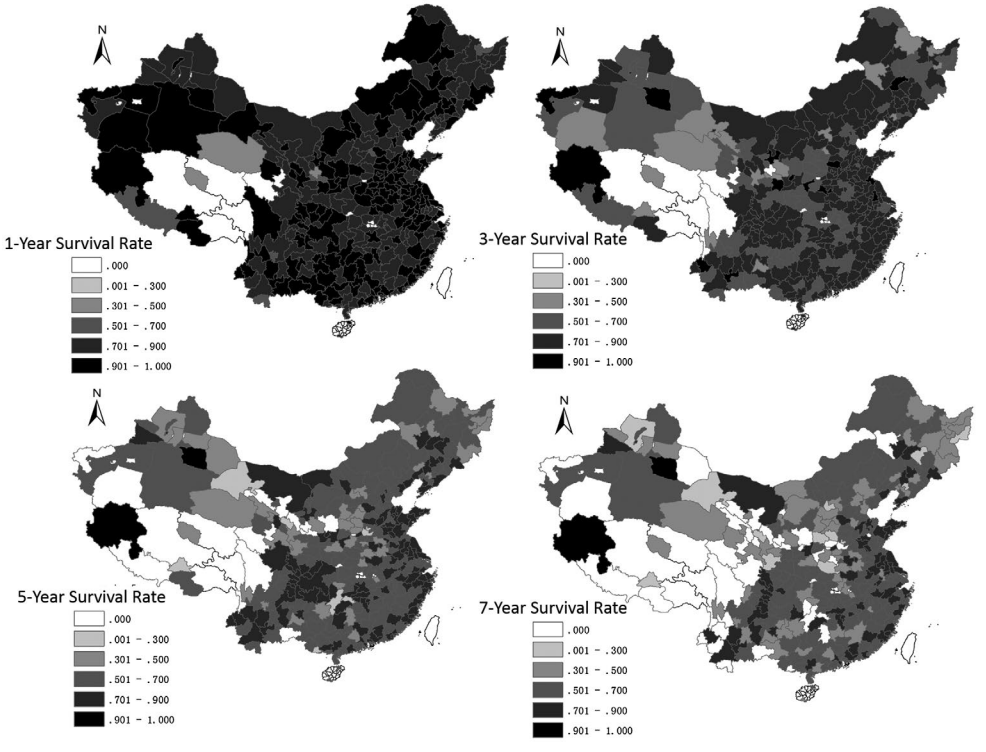

Figure 1. Kaplan–Meier survival estimates of firms at the prefectural city level.

right-censoring in time-series data in which the event of interest might not occur within the study period. The basic Cox PH model is defined as

$$h_i(t) = h_0(t)\exp(X_i\beta)$$

where $h_0(t)$ is the baseline hazard function, X is a vector of independent variables, and β is a corresponding vector of coefficients. The subscript i denotes the individual firm. This model is semi-parametric because the baseline hazard function $h_0(t)$ can be unspecified; the covariates enter the model linearly

$$\log h_i(t) = \alpha(t) + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik}$$

where $\alpha(t) = \log h_0(t)$. The Cox model is estimated by the maximisation of the partial likelihood function developed by Cox (1972).

4.2. Explanatory variables

Traditional measures of knowledge spillover and agglomeration externalities, such as the Herfindahl index, the location quotient index and the co-agglomeration index designed by Ellison, Glaeser, and Kerr (2010), are *ex ante* measures derived from the predetermined hierarchical structure of the standard industrial classification (SIC) system. However, whether SIC-based relatedness measures are truly measures of industry relatedness is debatable (Neffke et al., 2011). Another measure of relatedness is based on similarities in upward and

downward linkages in input–output tables (Fan & Lang, 2000). However, input–output tables are typically compiled at the national level and contain a small number of aggregated industries. To measure the finer industry relatedness across four-digit Chinese industries, this study follows the co-occurrence analysis pioneered by Hidalgo et al. (2007). Similar measures of relatedness have also been adopted by Boschma and Capone (2016), Boschma and Iammarino (2009), Bryce and Winter (2009), Essletzbichler (2015) and Neffke et al. (2012). Boschma et al. (2012) note that the *ex-post* relatedness indicator developed by Hidalgo et al. (2007) based on a proximity product index can better capture the essence of industry relatedness than the conventional *ex ante* measure of related and unrelated variety (Boschma & Iammarino, 2009; Frenken et al., 2007) and the cluster-based *ex-post* indicator of industry relatedness formulated by Porter (2003).

The approach developed by Hidalgo et al. (2007) assumes that two industries are considered to be related with one another if the regions tend to have revealed comparative advantage (RCA) for both. RCA for an industry in a city is indicated by a location quotient greater than 0.5. The relatedness between industries *i* and *j* is measured as the minimum conditional probabilities that cities specialised in industry *j* in terms of employment are also specialised in industry *i,* and *vice versa*:

$$\text{Relatedness}_{ij} = \min\left[P\left(\text{RCA}_i > 0.5|\text{RCA}_j > 0.5\right),\ P\left(\text{RCA}_j > 0.5|\text{RCA}_i > 0.5\right)\right]$$

The rationale behind this *ex post* relatedness indicator is that if two industries are related with one another, they probably demand similar institutions, infrastructure, factor inputs, capabilities and technology and are likely to be produced in the same region. Based on this measure, inter-industry relatedness is estimated for 424 four-digit manufacturing industrial sectors.

It is expected that a firm has a greater chance of survival if it belongs to an industry that is strongly related to local industrial sectors, as a high level of relatedness leads to intensive knowledge spillovers. To examine the impact of industry relatedness on firm survival, this study needs to measure the extent to which an industry is related to other industries in the same region. The relatedness of four-digit industry *i* in prefectural city *r* is given as

$$\text{IR}_{ri} = \sum_j (\text{Relatedness}_{ij} * \text{E}_{rj}) / \sum_j \text{E}_{rj}$$

where *r* represents the city, *i* denotes a four-digit industry to which a firm of interest belongs, *j* is another four-digit industry, and *E* represents employment.

In addition, five city-specific variables are also included. It is hypothesised that industry relatedness works more effectively in business survival in regions with strong market-oriented institutions and strong economic and political incentives from local governments. SOEs' production is often considered to predicate heavily on the state's social, political and military considerations; a large proportion of SOEs reflects a low level of marketisation. The proportion of non-SOEs' employment in the total (*C_MARKET*) is used to quantify the degree of economic liberalisation and market orientation in a city. Following Wu and Heerink (2016), two variables are introduced to capture the economic and political incentives of local administrations under China's decentralisation system. One is the ratio of local fiscal revenue to government expenditure (*C_D1*) to indicate fiscal self-reliance, and the other is local fiscal revenues per capita divided by the sum of local fiscal revenues per capita and central fiscal

revenues per capita (*C_D2*) to measure the relative size of local fiscal revenues compared with central revenues. Two city-specific control variables are included as well: the share of college students in a city as a proxy of human capital (*C_HCAP*) and road density – the length of highways over land area in a city – as a proxy of infrastructure (*C_INFRA*). High levels of human capital and infrastructure are both expected to help local businesses survive.

Some firm-specific variables are also added. Market-oriented firms are more likely to exploit industry relatedness to increase their survival probability, while SOEs may depend less on industry relatedness and knowledge spillovers but more on government supports. Dummy variables, *F_SOE* and *F_FOE*, are thus included, taking the value of 1 if a firm is an SOE/FOE and 0 otherwise. Likewise, the dummy variable *F_EXP* is introduced to measure if a firm is an exporter. Second, local governments commonly provide subsidies and loans to firms in their jurisdictions (Barbieri, Tommaso, Marco, & Bonnini, 2012), which may reduce firms' production costs and help firms survive, at least in the short run. Two firm-specific dummy variables are added: *F_SUB* and *F_LOAN* (whether a firm has received government subsidies and loans, respectively). Finally, large firms are often found to be more likely to survive (Audretsch & Mahmood, 1995). Scale economies underline the role of firm size. Meanwhile, scope economies will improve a firm's capability to cope with market uncertainty. This study applies employment to measure firm size (*F_SIZE*) and introduces the product variety of a firm (*F_PV*) to measure scope economies at the firm level. *F_PV* is a dummy variable that takes the value of 1 if firms produce two or more final products and 0 otherwise. Firms that produce more products are expected to have a better chance of survival due to scope economies.

Data on fiscal revenue, government expenditure, human capital and highway are taken from the China City Statistical Yearbook and China Statistical Yearbook for the Regional Economy. Data on all other variables are derived from the ASIF. All the explanatory variables are summarised in Table 2.

Table 2. Definitions of explanatory variables.

Variables	Definitions
IR	The extent to which an enterprise is related to advantageous industries in the city
C_MARKET	The proportion of non-SOEs' employment among the total at the city level
C_D1	The ratio of local fiscal revenue to government expenditure at the city level
C_D2	Local fiscal revenues per capita divided by the sum of local fiscal revenues per capita and central fiscal revenues per capita
C_HCAP	The share of college students in a city
C_INFRA	The length of highways over land area in a city
F_SOE	Dummy variable for state-owned enterprises
F_FOE	Dummy variable for foreign-owned enterprises
F_EXP	Dummy variable for exporters
F_SUB	Dummy variable for enterprises with subsidies
F_LOAN	Dummy variable for enterprises with bank loans
F_SIZE	Firm employment
F_PV	Dummy variable for enterprises with two or more final products
INDUSTRY	Dummy variable for two-digit industries
PROVINCE	Dummy variable for provinces where an enterprise is located
YEAR	Dummy variable for years when an enterprise is created

5. Empirical results

5.1. Industry relatedness and new firm survival

The correlation analysis indicates that there is no serious multi-collinearity problem. In the estimations, each observation represents a firm that was established in a specific year (from 1999 to 2007), and we track information on these firms' existence in subsequent years up to 2008. All independent variables for each observation are calculated based on the data in the firm's birth year. The logarithms of *F_SIZE* and *C_INFRA* are taken in our estimations. Industry, year and region dummy variables are included to control industry-, region- and time-specific effects. The dummy variable for industry (*INDUSTRY* in Table 3) is measured at the two-digit level, and the region dummy is measured at the provincial level (*PROVINCE* in Table 3).

In the Cox PH model, the coefficients of the explanatory variables show the effect of these explanatory variables on the hazard rate. A positive coefficient indicates that larger values of the explanatory variable increase the risk of firm failure, whereas a negative coefficient suggests that the variable is negatively associated with the hazard rate and therefore helps firms survive. First, Model 1 in Table 3 shows that industry relatedness helps firms maintain their competitiveness (H1). If a firm belongs to a four-digit industry that is closely related to other local industrial sectors in the same city, the firm has a better chance of survival. Local competence and localised business networks derived from strong inter-industry relatedness generate intensive agglomeration externalities and knowledge spillovers for related firms. Due to high levels of relatedness and cognitive proximity between firms, it is quite easy not only for labour to move among related firms but also for ideas and know-how to flow within a local business network. The benefits that firms can gain from relatedness are limited. The

Table 3. Estimation results on industry relatedness and regional institutions.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
IR	−0.641***	−1.620*	−2.024***	0.653	−1.263***	−0.580**
*IR*IR*		2.574***	2.191***			
*IR*C_MARKET*		−1.677**		−1.595**		
*IR*C_D1*		1.453**			0.997*	
*IR*C_D2*		−0.462				−0.146
C_MARKET	−0.136	0.359	−0.134	0.327	−0.131	−0.136
C_D1	−0.207***	−0.640***	−0.199***	−0.210***	−0.510***	−0.207***
C_D2	0.112	0.264	0.114	0.120	0.113	0.155
C_HCAP	0.133	0.188	0.213	0.041	0.208	0.116
C_INFRA	−0.052*	−0.051*	−0.053*	−0.049	−0.054*	−0.052*
F_SOE	0.453***	0.450***	0.452***	0.452***	0.452***	0.453***
F_FOE	−0.163***	−0.163***	−0.162***	−0.163***	−0.163***	−0.163***
F_EXP	−0.122***	−0.120***	−0.122***	−0.121***	−0.122***	−0.122***
F_SUB	−0.170***	−0.170***	−0.171***	−0.169***	−0.170***	−0.170***
F_LOAN	−0.097***	−0.096***	−0.097***	−0.097***	−0.097***	−0.097***
F_SIZE	−0.209***	−0.209***	−0.209***	−0.209***	−0.209***	−0.209***
F_PV	−0.074***	−0.074***	−0.073***	−0.074***	−0.074***	−0.074***
INDUSTRY	Included	Included	Included	Included	Included	Included
PROVINCE	Included	Included	Included	Included	Included	Included
YEAR	Included	Included	Included	Included	Included	Included
Observations	45,826	45,826	45,826	45,826	45,826	45,826
LR Chi2	4396	4414	4403	4401	4399	4396
Prob > Chi2	0	0	0	0	0	0

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

significant nonlinear effect of industry relatedness (*IR*IR*) in Models 2 and 3 confirms the notion that an optimal level of cognitive distance may exist in knowledge spillovers (Nooteboom, 2000).

All firm-specific variables show a relationship with firm survival that is consistent with theoretical predictions. SOEs tend to have a higher failure rate, while FOEs are able to survive for a longer period. SOEs are often considered as less productive and efficient than POEs and FOEs in communist and post-communist economies because they are often spoiled by government supports and protections (Ahrend & Martins, 2003). Furthermore, China's reform of SOEs in the late 1990s and early 2000s, which sought to sell off unproductive SOEs and lay off SOE workers to improve efficiency, may have also contributed to SOEs' higher failure rate (Ho & Young, 2013). In contrast, foreign firms in China enjoy ownership advantages from their parent companies and institutional advantages and are thus less likely to fail. *F_EXP* has a negative and significant coefficient, showing that exporters are more likely to survive (see also Kimura and Kiyota (2006)). Exporters can learn from exporting and often tap into both domestic and international markets. *F_LOAN* and *F_SUB* both have negative and significant effects on the firm failure rate, indicating that subsidies and banks loans provided by local governments have reduced firms' production costs and enabled them to survive temporarily. Finally, firms with higher levels of scale economies (*F_SIZE*) and scope economies (*E_PV*) are more vigorous and resilient.

5.2. The impact of regional institutions

Overall, the city-specific variables play less significant roles in firm survival. Regional institutional arrangements in China also have an impact on firm survival. As shown in Model 1 in Table 3, the coefficient of decentralisation (*C_D1*) is significantly negative, implying that the economic or political incentives of local governments can directly lower the failure rates of new firms. However, marketisation is insignificant, suggesting that firms in the region with higher levels of marketisation do not show higher survival rates, probably as a result of fiercer competition accompanied by higher levels of marketisation. Investments in infrastructure and human capital foster the formulation of a favourable environment for entrepreneurial activities and lower firms' production costs, although the impact of human capital is not significant in the models.

Finally, moving on to the results that are more closely connected to the central argument (Model 2, 4–6 in Table 3), the interaction term between *IR* and *C_MAR* has a negative and significant sign, suggesting that relatedness has a greater impact on firm survival in more market-oriented regions (**H2**). The rationale behind this finding is that firms are increasingly dependent on industry relatedness and knowledge spillovers within market-oriented regional institutions which can provide more free and fair market environment. *IR*C_D2* is insignificant, but the interaction terms between *IR* and *C_D1* have a positive and significant relationship with firm failure (**H3**). That is, as less revenue meets the needs of its expenditures, local governments become more motivated to help firms survive through pro-business policies, which create an unfairly competitive environment and thus infect the role of industry relatedness and knowledge spillovers in firm survival. Large numbers of pro-business policies may not encourage firms from innovating and improving efficiency but rather make them become increasingly reliant on government supports.

5.3. The impact of firm heterogeneity

To testify H4, samples are first divided into three groups: large firms (employment greater than 200 persons), medium (employment between 50 and 200 persons) and small firms (employment smaller than 50 persons) and run the estimation models for each group (Models 1–3 in Table 4). Models 4–8 report empirical results for SOEs, FOEs, POEs, and firms that have received government subsidies and those that have not, respectively.

The key findings are as follows. Since the estimated parameters of city-specific and firm-specific variables are mostly unaltered, we focus here on the coefficient of *IR* in various models to show how firm heterogeneity and industry relatedness have co-shaped firm survival in China's manufacturing industries. First, Models 1–3 in Table 4 show that relatedness has a relationship with firm survival that is consistent with theoretical predictions. Large firms enjoy scale economies and are more likely to survive by depending on their own competences rather than on industry relatedness. Additionally, it is much easier for large firms to access favourable policies (e.g. tax credits, subsidies, cheap land and government aid), driven by China's so-called 'grasp the large, let go the small' policies, the implicit and overarching spirit of which is to invigorate large key enterprises and to leave SMEs to fend for themselves (Zhu, He, & Liu, 2014). As a result, large firms tend to depend less on relatedness than SMEs. Likewise, the empirical results in Models 7–8 also suggest that government intervention has discouraged firms from taking advantage of knowledge spillovers and relatedness. Firms that are able to obtain direct government subsidies are less active in local business networks and rely on relatedness to a lesser extent than their counterparts without subsidies.

Second, the results in Model 4 also tell a similar story: SOEs depend on industry relatedness and knowledge spillovers to a lesser extent than POEs. A possible explanation is that even in post-reform China, financial aid and tax incentives have still been disproportionately

Table 4. Estimation results on industry relatedness and firm heterogeneity.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Large	Medium	Small	SOE=1	FOE=1	POE=1	SUB-SIDY=1	SUB-SIDY=0
IR	0.071	−0.709***	−0.867***	−0.853	−0.447	−0.701***	−0.888	−0.631***
C_MARKET	−0.139	−0.145	−0.073	0.297	−0.329	−0.137	−0.486	−0.129
C_D1	−0.240	−0.420***	0.085	0.226	−0.550**	−0.202**	−0.291	−0.211***
C_D2	−0.098	0.205*	0.070	−0.113	0.452**	0.083	−0.318	0.134
C_HCAP	3.686	0.224	−1.183	−9.419	−5.318**	1.011	7.908*	−0.201
C_INFRA	0.021	−0.092**	−0.039	−0.175	−0.095	−0.047	−0.172	−0.047
F_SOE	0.383***	0.458***	0.480***				0.623***	0.441***
F_FOE	−0.202***	−0.119***	−0.146**				−0.025	−0.168***
F_EXP	−0.084	−0.148***	−0.113*	−0.141	−0.096*	−0.133***	−0.151	−0.119***
F_SUB	−0.146	−0.207***	−0.193**	0.007	−0.069	−0.206***		
F_LOAN	−0.149***	−0.107***	−0.058*	−0.175	−0.104*	−0.093***	−0.120	−0.097***
F_SIZE	−0.084**	−0.244***	−0.179***	−0.175***	−0.256***	−0.208***	−0.190***	−0.210***
F_PV	−0.131**	−0.055	−0.078*	−0.081	−0.140**	−0.058**	−0.129	−0.074***
INDUSTRY	Included	Included	Included	Included	Included	Included	Included	Included
PROVINCE	Included	Included	Included	Included	Included	Included	Included	Included
YEAR	Included	Included	Included	Included	Included	Included	Included	Included
Observations	8537	22,437	14,852	716	7440	37,670	1997	43,829
LR Chi2	647.1	1980	1810	180.2	591.7	3490	227.2	4216
Prob > Chi2	0	0	0	0	0	0	0	0

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

assigned to SOEs, and some purportedly industry-wide policies have been applied preferentially to favour SOEs (see also Bai, Du, Tao, and Tong (2004) for a similar argument on the complicated linkages between SOEs and China's various levels of government). SOEs have thus become less reliant on relatedness and knowledge spillovers than POEs that are often disadvantaged by government policies. However, in the FOE model, the relationship between relatedness and firm survival is not significant. Since China's reform and opening-up policies, the Chinese central and local governments have provided financial, political and technological supports in the form of tax credits, cheap land and labour in order to attract foreign direct investments, many of which are either located in export-processing zones along China's coastal regions or conducted labour-intensive, low-value export-processing production outside zones. On one hand, this process has resulted in a new type of 'race to the bottom' in which FOEs take advantage of government policies by searching for the most favourable policies, cheapest land and best tax credits and pitting local governments against each other. These FOEs in some cases became less interested in investing in production and innovation and more focused on capturing rents from government policies. On the other hand, this process also resonates with recent studies that have shown that FOEs tend to network among themselves resulting in weak local embeddedness, and they have not truly contributed to upgrading China's regional industries (Poncet & Starosta de Waldemar, 2013; Wei, 2010). Consequently, the linkages and knowledge exchange between FOEs, particularly those that conduct export-processing production and trade, and the regional economy can be limited; FOEs may thus depend less on industry relatedness with the regional economy.

5.4. Endogeneity issues and robustness check

An important concern involves the endogeneity between relatedness and firm survival. To exclude the possibility that unobserved characteristics of industries, regions and years create the observed relationship between firm survival and how they are related to other local industries and firms, our estimation models include industry-, region- and time-specific effects, which capture all scope economies that are common to all industries for a given region and year, to all regions for a given industry and year, or to all years for a given industry and region. This issue of endogeneity and omitted variables is also carefully addressed through the introduction of many possible variables, including firm- and city-specific variables, which may interfere with the observed relationship between firm survival and relatedness.

The issue of reverse causality is limited by the way in which the *IR* index is computed. First, the *IR* index is measured at the prefectural city level in the firm's birth year, whereas firm failure occurred at least 1 year after the birth year. The other explanatory variables follow suit. The use of lagged explanatory variables helps make up for the potential simultaneity problem. Second, the *IR* index is re-computed as

$$\mathrm{IR}_{ri} = \sum_{j \neq i} (\mathrm{Relatedness}_{ij} * \mathrm{E}_{rj}) / \sum_{j \neq i} \mathrm{E}_{rj}$$

In other words, when we compute the *IR* index for a firm in industry *i* in prefectural city *r*, industry *i* is excluded (i.e. $j \neq i$). Direct reverse causality can be safely excluded because the explained variable (the performance of the firm in industry *i*) does not enter into the computation of the *IR* index. The revised *IR* index is strongly correlated with the original one: the

correlation coefficient is 0.9933. Furthermore, empirical results using the revised *IR* index in Model 1 and Model 2 in Table 5 show that the relationship between relatedness and firm survival does not change.

A series of alternative estimation methods are adopted to check the robustness of relationship between industry relatedness and new firm survival (Table 5). Models 3–6 show results using exponential and Weibull survival distribution, explained in the same way as the Cox PH model since their dependent variables are all the risk of firm failure. The coefficient of *IR* and other variables correlated with *IR* show that Hypotheses 1–3 are proven and that there is little difference in the results between the models and the Cox PH model. In addition, the proportionality assumption of the Cox PH model is so strong that it is frequently violated, but the accelerated failure time (AFT) model is an alternative model specification since it has a time-scaling factor that can avoid violating the proportionality assumption. Its dependent variable is based on duration, so the coefficient of *IR* is expected to be positive. The results in Models 7–10 are consistent with Hypotheses 1–3, implying that the findings based on the Cox PH model are robust.

Finally, as a robustness check, all models are also estimated using different threshold values (e.g. 0.8 or 1) to determine a RCA in the computation of the *IR* index. Compared with the results presented above, these changes produce only minor effects.[1]

6. Summary and Implications

Externalities have long been reported to underpin new firm survival. Recent EEG studies have taken this question one step further and highlighted the role of cognitive proximity and industry relatedness in growth, employment, productivity and innovation of regions and firms. However, these studies pay insufficient attention to the differences that knowledge spillovers can show across regions and, more importantly, to the possible effect of regional institutions on the intensity and nature of the knowledge spillover process. Even less attention has been paid to firm heterogeneity in the recent industry relatedness literature. This study made a special effort to explore the importance of industry relatedness in Chinese firms' survival while simultaneously considering regional institutional contexts and firm heterogeneity.

This study has investigated the probability of new firm survival during the 1999–2008 period and how this process has been co-shaped by the articulation between industry relatedness, regional institutions and firm heterogeneity. Based on a firm-level dataset of China's manufacturing industries, a co-occurrence approach is adopted to calculate industry relatedness at the four-digit industry level and at the prefectural city level. Regression results confirm that industry relatedness lowers the failure rate of new firms and helps them survive longer. More importantly, the relationship between firm survival and industry relatedness is affected by regional institutional frameworks and firm heterogeneity, particularly in transitional economies such as China, where economic and political reform has resulted in enormous spatial variation in economic and institutional landscapes. First, relatedness has a greater impact on firm survival in more market-oriented regions, as industry relatedness and knowledge spillovers are more effective when better market-oriented regional institutions are in place. Relatedness has a lower impact on firm survival when local governments play a supportive and facilitating role. Second, different types of firms benefit from relatedness and knowledge spillovers to different extents. Specifically, large firms lack incentives

Table 5. Regression results of alternative measures and model estimations.

	Revised relatedness index (excluding the focal industry)		Firm failure				Firm survival: accelerated failure time model			
			Weibull	Weibull	Exponential	Exponential	Weibull	Weibull	Exponential	Exponential
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
IR	−0.755***	−1.930*	−0.697***	−2.083**	−0.680***	−1.960**	0.593***	1.773**	0.680***	1.960**
*IR*IR*		3.462**		2.813***		2.753***		−2.394***		−2.753***
*IR*C_MARKET*		−1.951**		−1.368*		−1.446**		1.164*		1.446**
*IR*C_D1*		1.817**		1.684**		1.623**		−1.433**		−1.623**
*IR*C_D2*		−0.606		−0.792		−0.712		0.674		0.712
C_MARKET	−0.138	0.399	−0.225**	0.183	−0.204**	0.226	0.192**	−0.156	0.204**	−0.226
C_D1	−0.207***	−0.707***	−0.234***	−0.734***	−0.228***	−0.710***	0.199***	0.625***	0.228***	0.710***
C_D2	0.116	0.299	0.128	0.377	0.124	0.350	−0.109	−0.321	−0.124	−0.350
Observations	45,826	45,826	45,826	45,826	45,826	45,826	45,826	45,826	45,826	45,826
LR Chi2	4394	4410	3012	3031	3434	3453	3012	3031	3434	3453
Prob > Chi2	0	0	0	0	0	0	0	0	0	0

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$; Each specification includes all controls from Table 3 and the corresponding significance and coefficients have little difference from those in Table 3.

to exploit relatedness not only because they enjoy scale economies but also because of China's so-called 'grasp the large, let go the small' policies that provide favourable government support for large firms. Direct government intervention has also distorted the relationship between knowledge spillovers and firm survival for SOEs, FOEs and firms that have received government subsidies. This study also shows that FOEs, particularly those that conduct export-processing production and trade, tend to network among themselves and thus depend less on industry relatedness with the regional economy.

Several policy implications can be drawn from the empirical findings. First, policy makers should aim to foster a more market-oriented, less state-led business environment in order to reinforce the positive impact of industry relatedness and knowledge spillovers on firm survival. Second, China's central and local government should seek to be a 'facilitator', investing in public services and goods and fostering a nurturing environment, rather than playing an intervening, hands-on role and distorting regional economic development with tax rebates and subsidies. Worse, direct government intervention in the form of subsidies may compromise knowledge spillovers and technology transfers in local business networks. Third, this study has also noted the drawback of China's opening-up policies, which may give rise to a new type of strategic 'race to the bottom' in which FOEs take advantage of government policies by searching for the most favourable policies, cheapest land and best tax credits and pitting local governments against each other. Other studies also note that FOEs, particularly those that are concentrated in export-processing zones or that conduct export-processing production elsewhere have not truly contributed to upgrading China's regional industries. Hence, it is time for the Chinese central and local governments to rethink their obsession with the strategy of attracting foreign direct investments to boost GDP, as this study reveals that FOEs have been less interested in participating in local business networks and have sometimes developed in a relatively 'isolated' way.

Note

1. Due to space limitations, estimation results for these robustness checks are not reported here but are available on request.

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References

Acs, Z. J., Armington, C., & Zhang, T. (2007). The determinants of new-firm survival across regional economies: The role of human capital stock and knowledge spillover. *Papers in Regional Science, 86*, 367–391.

Ahrend, R., & Martins, O. (2003). Creative destruction or destructive perpetuation: The role of large state-owned enterprises and SMEs in romania during transition. *Post-Communist Economies, 15*(3), 331–356.
Audretsch, D. B. (1991). New-firm survival and the technological regime. *The Review of Economics and Statistics, 73*(3), 441–450.
Audretsch, D. B., & Mahmood, T. (1995). New firm survival: New results using a hazard function. *The Review of Economics and Statistics, 77*, 97–103.
Bai, C. E., Du, Y., Tao, Z., & Tong, S. Y. (2004). Local protectionism and regional specialization: Evidence from China's industries. *Journal of International Economics, 63*(2), 397–417.
Bai, C. E., Lu, J., & Tao, Z. (2009). How does privatization work in China? *Journal of Comparative Economics, 37*(3), 453–470.
Barbieri, E., Tommaso, D., Marco, R., & Bonnini, S. (2012). Industrial development policies and performance in Southern China: Beyond the specialized industrial cluster program. *China Economic Review, 23*(3), 613–625.
Basile, R., Pittiglio, R., & Reganati, F. (2017). Do agglomeration externalities affect firm survival? *Regional Studies, 51*(4), 548–562.
Boschma, R. A. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*(1), 61–74.
Boschma, R., & Capone, G. (2016). Relatedness and diversification in the European Union (EU-27) and European neighbourhood policy countries. *Environment and Planning C: Government and Policy, 34*(4), 617–637.
Boschma, A. R. A., & 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., & Frenken, K. (2011). Industry relatedness and regional branching. In H. Bathelt, M. P. Feldman, & D. F. Kogler (Eds.), *Beyond territory: Dynamic geographies of knowledge creation, diffusion and innovation* (pp. 64–81). Routlege: London.
Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages, and regional growth in Italy. *Economic Geography, 85*(3), 289–311.
Boschma, R. A., & Wenting, R. (2007). The spatial evolution of the British automobile industry: Does location matter? *Industrial and Corporate Change, 16*(2), 213–238.
Boschma, R., Minondo, A., & Navarro, M. (2012). Related variety and regional growth in Spain. *Papers in Regional Science, 91*(2), 241–256.
Boschma, R., Minondo, A., & Navarro, M. (2013). The emergence of new industries at the regional level in Spain: A proximity approach based on product relatedness. *Economic Geography, 89*(1), 29–51.
Bryce, D. J., & Winter, S. G. (2009). A general interindustry relatedness index. *Management Science, 55*(9), 1570–1585.
Combes, P. P., & Gobillon, L. 2015. The empirics of agglomeration economies. In G. Duranton, V. Henderson, & W. Strange (Eds.), *Handbook of urban and regional economics* (Vol. 5, pp. 247–348). Amsterdam: Elsevier.
Cox, D. R. 1972. Regression models and life tables. *Journal of the Royal Statistical Society, Series B (Methodological), 34*(2), 187–220.
De Silva, D. G., & McComb, R. P. (2012). Geographic concentration and high tech firm survival. *Regional Science and Urban Economics, 42*(4), 691–701.
Delgado, M., Porter, M. E., & Stern, S. (2010). Clusters and entrepreneurship. *Journal of Economic Geography, 10*(10), 495–518.
Duranton, G., & Puga, D. 2004. Micro-foundations of urban agglomeration economies. In J. Henderson & J.-F. Thisse (Eds.), *Handbook of regional and urban economics* (Vol. 4, pp. 2063–2117). Amsterdam: Elsevier.
Ellison, G., Glaeser, E. L., & Kerr, W. R. (2010). What causes industry agglomeration? Evidence from coagglomeration patterns. *The American Economic Review, 100*(3), 1195–1213.
Essletzbichler, J. (2015). Relatedness, industrial branching and technological cohesion in US metropolitan areas. *Regional Studies, 49*(5), 752–766.
Fan, J. P., & Lang, L. H. (2000). The measurement of relatedness: An application to corporate diversification. *The Journal of Business, 73*(4), 629–660.

Fan, C. C., & A. J. Scott (2003). Industrial agglomeration and development: A survey of spatial economic issues in East Asia and a statistical analysis of Chinese regions. *Economic geography, 79*(3), 295–319.
Fontana, R., & Nesta, L. (2009). Product innovation and survival in a high-tech industry. *Review of Industrial Organization, 34*(4), 287–306.
Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41*(5), 685–697.
Görg, H., & Strobl, E. (2003). Multinational companies, technology spillovers and plant survival. *The Scandinavian Journal of Economics, 105*(4), 581–595.
Guo, Q., He, C., & Li, D. (2016). Entrepreneurship in China: The role of localisation and urbanisation economies. *Urban Studies, 53*(12), 2584–2606.
Han, S. S., & Pannell, C. W. (1999). The geography of privatization in China, 1978-1996. *Economic Geography, 75*(3), 272–296.
He, C. (2002). Information costs, agglomeration economies and the location of Foreign direct investment in China. *Regional Studies, 36*, 1029–1036.
He, C., & Pan, F. (2010). Economic transition, dynamic externalities and city-industry growth in China. *Urban Studies, 47*(1), 121–144.
He, C., & Yang, R. (2016). Determinants of firm failure: Empirical evidence from China. *Growth and Change, 47*(1), 72–92.
He, C., Wei, Y., & Xie, X. (2008). Globalization, institutional change, and industrial location: Economic transition and industrial concentration in China. *Regional Studies, 42*, 923–945.
Hidalgo, C. A., Klinger, B., Barabasi, A. L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science, 317*, 482–487.
Ho, D., & Young, A. (2013). China's experience in reforming its state-owned enterprises: Something new, something old and something Chinese? *International Journal of Economy, Management and Social Sciences, 2*(4), 84–90.
Howell, A., He, C., Yang, R., & Fan, C. (2016). Agglomeration, (un)-related variety and new firm survival in China: Do local subsidies matter? *Papers in Regional Science* (online).
Jacobs, J. (1969). *The economy of cities*. New York, NY: Random House.
Kaplan, E. L., & Meier, P. (1958). Non-parametric estimation from incomplete observations. *Journal of the American Statistical Association, 53*, 457–481.
Kimura, F., & Kiyota, K. (2006). Exports, FDI, and productivity: Dynamic evidence from Japanese firms. *Review of World Economics, 142*, 695–719.
Li, H., & Zhou, L. A. (2005). Political turnover and economic performance: The incentive role of personnel control in China. *Journal of Public Economics, 89*(9), 1743–1762.
Litzel, N. 2017. Does embeddedness in clusters enhance firm survival and growth? An establishment-level analysis using CORIS data. *Regional Studies, 51*(4), 563–574.
Lu, J. (2010). Agglomeration of economic activities in China: Evidence from establishment censuses. *Regional Studies, 44*, 281–297.
Marshall, A. (1898). *Principles of economies* (Vol. 1). London: Macmillan.
Neffke, F. H. M., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*(3), 237–265.
Neffke, F. H. M., Henning, M., & Boschma, R. (2012). The impact of aging and industry relatedness on agglomeration externalities: A survival analysis. *Journal of Economic Geography, 12*(2), 485–517.
Nooteboom, B. (2000). Learning by interaction: Absorptive capacity, cognitive distance and governance. *Journal of Management and Governance, 4*(1–2), 69–92.
Oi, J. C. (1992). Fiscal reform and the economic foundations of local state corporatism in China. *World Politics, 45*(1), 99–126.
Pan, F., Zhang, F., Zhu, S., & Wójcik, D. (2016). *Developing by borrowing? Inter-jurisdictional competition*. Urban Studies: Land Finance and Local Debt Accumulation in China.
Poncet, S., & Starosta de Waldemar, F. (2013). Export upgrading and growth: The prerequisite of domestic embeddedness. *World Development, 51*, 104–118.
Porter, M. (2003). The economic performance of regions. *Regional studies, 37*(6–7), 545–546.

Wei, Y. H. D. (2001). Decentralization, marketization, and globalization: The triple processes underlying regional development in China. *Asian Geographer, 20*(1–2), 7–23.
Wei, Y. H. D. (2010). Beyond new regionalism, beyond global production networks: Remaking the Sunan model, China. *Environment and Planning C: Government and Policy, 28*(1), 72–96.
Wennberg, K., & Lindqvist, G. (2010). The effect of clusters on the survival and performance of new firms. *Small Business Economics, 34*(3), 221–241.
Wu, Y., & Heerink, N. (2016). Foreign direct investment, fiscal decentralization and land conflicts in China. *China Economic Review, 38*, 92–107.
Yu, J., Zhou, L. A., & Zhu, G. (2016). Strategic interaction in political competition: Evidence from spatial effects across Chinese cities. *Regional Science and Urban Economics, 57*, 23–37.
Zhu, S., & He, C. (2015). Global and local governance, industrial and geographical dynamics: A tale of two clusters. *Environment and Planning C: Government and Policy, 34*, 1453–1473.
Zhu, S., He, C., & Liu, Y. (2014). Going green or going away: Environmental regulation, economic geography and firms' strategies in China's pollution-intensive industries. *Geoforum, 55*, 53–65.
Zhu, S., He, C., & Zhou, Y. 2017. How to jump further and catch up? Path-breaking in an uneven industry space. *Journal of Economic Geography, 17*(3), 521–545.