

Borowiecki, Martin; Leitner, Karl-Heinz

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Regional determinants of new business formation in China: Prefecture-level evidence

Martin Borowiecki and Karl-Heinz Leitner

Draft version, please do not quote!

Abstract. Using a panel data model, we study the effects of regional and industry-level traits on new business formation (NBF) for 164 industries across 266 Chinese prefectures between 1998 and 2007. The objective is to provide empirical estimates on effects of prefecture traits on entry rates, and in particular on effects of prefecture knowledge capital stocks on R&D-intensive new business formation. In line with literature on knowledge spillovers, we find extensive evidence of a positive prefecture knowledge capital stock effect on R&D-intensive NBF rates, whereas knowledge capital stocks do not predict non R&D-intensive entry rates. Among regional and industry-level characteristics, we find that prefecture supplier and customer market strength are strongly linked to higher business entry rates. Our results for China contrast with recent findings on the effects of regional traits on firm entry rates in India and the US, indicating distinct regional patterns of Chinese entrepreneurship.

Keywords: New business formation; Knowledge spillovers; Agglomeration economies; China

1. Introduction

During the last two decades of rapid industrialisation, new firm formation in manufacturing has contributed significantly to China's export-led growth model (Brandt et al. 2012; Guo et al. 2013). However, the country's manufacturing base consists mainly of lower value added assembly activities which reflect the perception of "China as the world's workbench" (Yu et al. 2009). Having realised the importance of industrial upgrading in its 12th Five Year Plan of 2011, Chinese policy has set the stage for increased efforts to upgrade its industrial structure towards higher-end, innovative activities.

In this regard, new business formation (NBF) has gained Chinese policy interest for its effects on job growth and innovation (Fritsch 2008; Audretsch et al. 2011). NBF affects industrial upgrading, among others, through entrepreneurial ventures in new fields of industrial specialisation as well as in already existing fields of competitive advantage of higher value added (Saxenian 1991; Simmie and Martin 2010).

China's has steadily increased its efforts to attract knowledge-intensive activities, reflected by recent increases in research and development (R&D) expenditures as percentage of its GDP (Jefferson et al. 2006; Crescenzi et al. 2012). Given these efforts and China's industrial knowledge gap, the question is whether the growth in science, technology and innovation (STI) inputs translates into growth in knowledge-intensive NBF, as suggested by literature on developed countries (Scherer 1984; Kirzner 1973; Metcalfe 2002; Audretsch and Keilbach 2004).

Thus, the focus of the current study is on investigating the link between knowledge production and manufacturing new business formation (NBF) in China at the prefecture level¹. We define NBF following Stam (2008) as the establishment of a new business with the purpose to introduce new economic activities, such as new or improved goods, services, production processes, etc. by entrepreneurs with the aim to induce changes in the market place (Stam 2008). The last decade has seen the development of a significant body of empirical research on determinants of NBF (for an overview, see Bruton et al. 2008). The research has shown that variations in NBF across countries and regions can be explained,

¹ Hereafter, we use prefecture and region synonymously.

among others, by differences in knowledge and entrepreneurial opportunities (Schumpeter 1934; Kirzner 1973; Metcalfe 2002; Audretsch and Keilbach 2004; Audretsch et al. 2011). In general, NBF has been shown to be a spatially uneven process and regions with higher rates of NBF are characterised by rich knowledge-based location factors (Zucker et al. 1998; Feldman 2001; Malmberg and Maskell 2002; Kirchof et al. 2007; Acs et al. 2008; Qian and Acs 2013). High-tech firms, in particular, benefit from better access to local knowledge and knowledge spillovers from incumbent firms (Audretsch and Feldman 1996; Audretsch and Lehmann 2005). Anselin, Varga, and Acs (1997) analyse empirically the relation between university research and high technology innovation for the US case, showing that knowledge flows are localised, where knowledge seems to flow from large to small firms in a region.

While for the Chinese case the effects of NBF on employment and growth have been widely investigated in previous empirical works (Yang and Xu 2006; Rho and Gao 2012; Li et al. 2012), there is only scarce evidence on the effects of knowledge production on NBF. To the authors' knowledge, one notable exception is the study of Rho and Moon (2014) who relate expenditures on R&D and NBF to regional patent growth as a measure of regional innovation for 31 Chinese provinces. The study provides statistically significant evidence for the positive impact of R&D expenditures on innovation but suggests a rather limited role of NBF. However, their study focuses on Chinese provinces while entrepreneurship and knowledge spillovers are shown to be more localised phenomena (for a discussion, see Audretsch et al. 2011). This calls for a more disaggregated prefecture-level perspective.

In the light of this background, this present study empirically estimates the effects of regional and industrial determinants, and in particular of regional knowledge stocks as measured by patent counts on NBF rates in China for the period 1998 to 2007. In doing so, we focus – in contrast to Rho and Moon (2014) – on firm entry in manufacturing sectors giving special emphasis on R&D-intensive new businesses at the level of Chinese prefectures.

The paper is related to several strands in the literature. Since we are interested in the effects of regional knowledge creation on entrepreneurship, we study this relationship from the lens of the knowledge spillover concept of entrepreneurship, e.g., as used for the European and US case by Kirchof et al. (2007), Acs et al (2008), and Braunerhjelm et al. (2010). In line with existing literature on developed countries, we assume that local knowledge stocks are

positively related to R&D-intensive NBF across Chinese prefectures. In contrast, the share of new product sales in overall output of incumbents is inversely related to NBF, which suggests that we expect higher rates of NBS in prefectures where incumbents commercialise entrepreneurial opportunities to a lesser extent.

Further, we build on the work of Glaeser and Kerr (2009), Ghania et al. (2014) and Cal á et al. (2014) in urban economics who examine the role of regional traits on firm entry across metropolitan areas. For India, for instance, Ghania et al. (2014) show that local cost advantages, the education level of the workforce, and the strength of customer and supplier markets are the strongest predictors of NBF, in line with the results of Gleaser and Kerr (2009) for the US. Our results for China contrast with their results as education of regional workforce and small supplier strength (Chinitz 1961) do not predict NBF, as opposed to local knowledge production measures and the level of local supplier and customer strength.

Finally, this paper is related to work on regional entrepreneurship in China. This is the first study that gives systematic evidence on the spatial pattern of industrial firm entry, putting special emphasis on R&D-intensive industrial firm entry, across Chinese prefectures. Thereby, we provide some evidence on different regional regimes of entrepreneurship as introduced by Zhou (2011), Chow (2002) and Mantinola et al. (1995). Our results confirm the importance of differences in the industrial ownership structure for NBF across prefectures. Interestingly, R&D-intensive NBF are concentrated in selected prefectures and municipalities with above average private sector ownership of the incumbent industry.

The remainder of the paper is organised as follows. Section 2 introduces the recent developments of NBF in China and presents a literature review on regional determinants of NBF, laying special emphasis on the role on regional knowledge production for firm entry in the Chinese context. Section 3 sets forth with the methodological framework by introducing the panel data model to be used for empirical testing and describing the data. Section 4 presents and discusses the estimation results. The final section concludes with a summary of the main results, some policy implications as well as ideas for a future research agenda.

2. Literature review and hypotheses

In this chapter, we describe new business formation in the Chinese context and provide a literature review on regional and industrial determinants of new business formation. First, we introduce private entrepreneurship in China and recent policy initiatives to foster its developments across Chinese provinces. Second, we discuss regional and industrial traits that are used in literature to explain differences in new business formation across countries and regions. We consider general regional traits, regardless of industry, and then we introduce some measures of industry-specific traits that capture industrial heterogeneity within a region. The inclusion of industrial traits that are specific to a region is in line with recent research that stresses the importance of heterogeneity across industries for explaining start-up rates (e.g. Fritsch and Falck 2007; Glaeser and Kerr 2009).

2.1 *New business formation in China*

New business formation (NBF) can be defined as the establishment of a new business with the purpose to introduce new economic activities, such as new or improved goods, services, production processes, etc. by entrepreneurs with the aim to induce changes in the market place (Stam 2008). In line with literature, the role of new businesses and particularly high-tech firms is to create new markets by linking new technologies and entrepreneurial opportunities to market needs, a process that Schumpeter (1911; 1942) described as competition *for* the markets. Also, entrepreneurs discover niches in already existing markets that have not been covered yet by incumbent firms – and fulfil existing market needs *given* available technologies (Kirzner 1973; 1997).

Evidence suggests that new business formation (NBF) has direct effects on employment growth through the creation of new jobs and production capacities². NBF, among others, is supposed to lead to static efficiency gains through increased competition. However, there is agreement in literature that the main economic effect of NBF are dynamic benefits among firms, where entrepreneurs seize upon existing technological opportunities and induces the reallocation of productive capacities into new sectors of higher value added (Fritsch 2008; Audretsch et al. 2011).

² However, new firm formation also leads to exit of existing capacities and job destruction when incumbents get displaced.

NBF thus plays a crucial role for industrial upgrading as described by Schumpeter's notion of "competition for the market". On a regional, new business formation is one mechanism for building new industrial specialisations of higher value added. Further, NBF is also related to increases in productivity through moving up the quality ladder within industries that are already present in the region (Simmie and Martin 2010).

In China, firm entry is spatially uneven process with the bulk of private new businesses being concentrated in coastal provinces. This reflects initial local entrepreneurial initiatives in provinces such as Guangdong and Zhejiang which benefited from decentralisation reforms in the late 1970s and early 1980s. Back then, local autonomy was granted to provincial and prefecture governments³. Entrepreneurial initiatives, mostly TVEs and family-run businesses in the early reform period, were thus treated differently depending on the local context: in parts of Guangdong and Zhejiang, local authorities either tolerated or actively supported private sector initiatives as a mean for generating wealth, while in the Southern Jiangsu regional developmental policies initially emphasized government ownership and restricted private entrepreneurship (Chow 2002; Mantinola et al. 1995). Zhou (2011) and Naughton (2007) suggest that successful local reforms were imitated in, or "spilled over" to, other regions leading to the gradual diffusion of new legal and market institution regulating entrepreneurial action across Chinese province.

Evidence suggests that private firms in China predominantly specialise in lower value added assembly activities⁴ and are rather oriented towards the wholesale import of foreign technology in form of inward investment than towards technology development (Yu et al. 2009). However, as indicated above, private entrepreneurship as driver of growth is rather recent phenomena in China: The rise in NBF and the re-emergence of the private sector have been a process that started only in the 1980. Formal economic legislation and social acceptance of private entrepreneurship has been gradually strengthened as late as in the 1990s and 2000s, including milestones such as the passing of the Company Law in 1993 and its amendment in 1999, the Partnership Enterprise Law in 1997, and the Individual-owned Enterprise Law (1999). Nonetheless, this gradual process has led to an overhaul of China's

³ As a result, local governments experimented with regulatory policies that were considered most appropriate for their own region, including emulation of successful policies in fast-growing regions.

⁴ By 2000, China was the world's major producer of labour-intensive processed consumer goods.

corporate system that culminated in 2004 with private ownership of production factors being formally recognised by the Chinese constitution (Xu and Zhang 2009).

Given this background, China's government has set the objective to increase private entrepreneurial activities, in particular in science, technology and innovation (STI) related fields⁵. Thereby, attention has been shifted towards the establishment of technology-oriented firms in order to pave the way for the commercialisation of results from major national science and technology programs (Yu et al. 2009; Li 2013). The strengthening of research commercialisation activities is supposed to support the restructuring of the Chinese innovation system and finally lead to a transformation of China into a knowledge-based economy. And given China's reliance on import of foreign technology, the emphasising has been laid on developing capabilities for "indigenous" or "home-grown innovation" (Song 2008; Creemers 2013).

Today, the Chinese Communist Party regards the private or "non-public" business sector as central in supporting growth and innovation⁶. Along with the privatisation of state and collective-owned firms in the last 20 years, it was in particular private entrepreneurial start-ups that have contributed to China's growth⁷. Estimates suggest that the entrance of new firms and the restructuring of state-owned enterprises to private-owned have contributed significantly to the growth of the private sector after 1998 (Brandt et al. 2012).

⁵ The coordination of industrial policies with STI initiatives has been accompanied by the establishment of the Ministry of Science & Technology (MOST) in 1998 and other landmarks political settings, such as the law for promoting commercialisation of science and technology, or the newly introduced and continuously improved patent law (see Song 2008, Rongping and Wan 2008, Ratchford and Blanpied, 2008)

⁶ The Central Committee of the Chinese Communist Party passed a resolution during its 3rd plenum in 2013 stating that "The non-public economy has an important role in supporting growth, stimulating innovation, broadening employment, enhancing fiscal income and other such areas ... in equality of rights, equality of opportunity and equality of regulations, eliminate all kinds and forms of unreasonable provisions affecting the non-public economy, eliminate all sorts of hidden barriers, formulate concrete rules for non-public enterprises to enter into specially-permitted areas of business." (Creemers 2013).

⁷ In manufacturing, the employment share of the private industrial sector has increased from 23% to 61% during the period 1995–2004 while the share of private industrial has seen an increase from 18% to 62% during the same period (Li et al. 2012).

2.2 Regional determinants of new business formation

There is agreement in literature that it is essential to understand the effects of general local area traits on entrepreneurship (for a discussion, see Michelacci and Silva 2007). Several studies relate, among other things, the educational level of the population to entrepreneurship (Glaeser et al. 2010; Doms et al. 2010). These studies often assume a positive relationship between education and the degree of creativity in the population as well as between education and the availability of business skills among the population. However, Glaeser and Kerr (2009) find limited evidence in this regard for new firm formation in the manufacturing sector at the level of U.S. metropolitan areas. Given the ambiguous evidence, it is important to account for the role of education for Chinese entrepreneurship.

Further, we focus on regional traits related to knowledge production. Evidence suggests that regions with higher rates of NBF are characterised by richer knowledge stocks (Zucker et al. 1998; Feldman 2001; Malmberg and Maskell 2002; Kirchof et al. 2007; Acs et al. 2008; Qian and Acs 2013). R&D-intensive firms, in particular, benefit from better access to local knowledge and knowledge spillovers from incumbent firms (Audretsch and Feldman 1996; Audretsch and Lehmann 2005; Audretsch et al. 2011). Incumbent firms contribute to knowledge by investing in R&D, and by producing new commercially viable knowledge such as patents and new products. However, due to the uncertainty regarding returns on investment in knowledge and the public-good characteristics of knowledge, incumbents are not able to fully recognise and appropriate the potential of knowledge opportunities (Arrow 1962).

New firms benefit from knowledge production of incumbents through localised knowledge spillovers (Acs et al. 2008; Qian and Acs 2013). Knowledge workers from incumbent firms, for instance, start a new venture to seize upon existing technological opportunities (Vivarelli 1991; Audia and Rider 2005). The knowledge stock of incumbent firms in the same or related industries in region determines entry rate and post-performance of spin-offs which exploit the knowledge of parent firms (Klepper 2001; Andersson and Klepper 2013).

Given our literature review on regional determinants of entrepreneurship, we suggest a differential impact of knowledge production on R&D-intensive firms vs. non R&D-intensive firms (Audretsch and Lehmann 2005; Qian and Acs 2013). We hypothesise that regional knowledge production affects R&D-intensive NBF differently as follows:

Hypothesis 1: R&D-intensive new business formation rates are higher in prefectures with higher levels of knowledge capital stocks.

Literature on China has stressed the importance of different regional regimes of entrepreneurship (Chow 2002; Mantinola et al. 1995; Zhou 2011). In fact, Chinese policy has recently focused on restructuring the biggest state-owned enterprises with focus on corporate management structures to increase productivity and innovation, while at the same time privatising smaller firms (Schweinberger 2014). This has happened in parallel to efforts to stimulate R&D and knowledge production as measured by invention patents. Given the importance of regional differences in the industrial ownership structure in China we propose the following hypothesis:

Hypothesis 2: New business formation rates are higher in prefectures with a higher share of private ownership of the incumbent industry.

Recent evidence suggests that new business formation varies considerably across industries and our second set of measures serves to quantify the effects of regional industrial traits for firm entry in a particular industry. Literature suggests higher rates of NBS are to be found in industries where incumbents commercialise entrepreneurial opportunities to a lesser extent (Acs et al 2008; Braunerhjelm et al. 2010). In light of the importance attributed to entrepreneurial opportunities for firm entry we test the following hypothesis for China:

Hypothesis 3: New business formation rates are higher in regional industries with lower share of new product sales in output sales of incumbent firms.

Less developed innovation systems lead to less entry irrespective of technological regime (Burachik 2000). The effect of knowledge on NBF depends also on local infrastructure and supplier-customer relationships (Saxenian 1994; Feldman 2001). From this baseline, we further include a measure on the extent to which industries interact through the traditional agglomeration rationales (e.g. Duranton and Puga 2004, Rosenthal and Strange 2004). In the context of China with its still underdeveloped infrastructure, we focus on the proximity to

customers and suppliers which reduces transportation costs and thereby increases productivity⁸. Therefore, we test the following hypothesis:

Hypothesis 4: New business formation rates are higher in prefectures with higher levels of supplier-customer relationships.

Besides agglomeration forces literature also shows that the presence of small suppliers in a region has an impact on firm entry (Chinitz 1961). Likewise, personal networks of nascent entrepreneurs tend to be local as they acquire information, knowledge and resources via local social networks of entrepreneurs, as shown by various studies for China (Nee 2005; Peng and Luo 2000; Wu 2006; Zhou 2013).

⁸ The transportation costs reduction lies at the core of the New Economic Geography theory (e.g. Fujita et al. 1999).

3. Data and methods

In this section we discuss the data used and the empirical setting of the study. We begin by presenting the sample of manufacturing entrants that are considered for our empirical analyses. We then focus our attention on the measurement of new business formation and discuss the independent variables used in our empirical analysis. Finally, we discuss the empirical model and estimation strategy used to explain differences in entrepreneurial patterns across Chinese prefectures.

3.1 Sample

Our panel data set is constructed using firm-level data on industrial establishments that is the product of annual surveys of industrial enterprises (*ASIE*) conducted by the National Bureau of Statistics (*NBS*) in China. The *NBS* data is an unparalleled data source for studying entrepreneurship among Chinese firms. The survey includes *all* industrial firms that are state-owned, and non-state-owned industrial firms with sales above 5 million RMB (approximately 500,000 EUR)⁹. The industrial sector includes mining, manufacturing and public utilities. In our study we solely use firm data from the manufacturing sector. This provides an original unbalanced panel of industrial establishments that increases in size from 148,685 firms in 1998 to 313,048 in 2007. Based on that dataset, we construct a balanced panel dataset of prefecture-industry pairs that are formed by crossing 266 Chinese regions with 164 industries for the ten year period from 1998 to 2007. Table 1 presents detailed descriptive statistics for our sample.

The *ASIE* dataset facilitates the characterisations of firm entry by prefectures, industries and ownership type of firms. Each establishment is given a unique, time-invariant identifier that can be longitudinally tracked¹⁰. This allows us to identify the year of entry of a new business or the opening of new plants by existing firms.

⁹ In 2004, the firms surveyed by *ASIE* employed 81.2% of the industrial workforce, produced 90.7% of industrial output and generated 97.5% of all industrial exports (National Bureau of Statistics 2005).

¹⁰ We use unique numerical IDs to link firms over time. Firms occasionally receive a new ID as a result of restructuring, merger, or acquisition, which is important to consider in the case of China after 1998. As many incumbents were restructured or privatised, we want to make sure not to lump these together with exiting firms or classify them as new entrants under a new ID. Where possible, we aim to keep a firm's ID after their ownership structure changes, using information on the firm's name, industry, and address to link them.

Table 1: Summary statistics before scaling

	N	Mean	Std.dev.	Min.	Max.
<i>Dependent variable</i>					
New business formation count	392616	0.81	4.16	0	316
R&D-intensive new business formation count	392616	0.01	0.18	0	40
New business formation rate	172378	24.68	53.60	0	3100
R&D-intensive new business formation rate	172378	0.21	3.63	0	300
<i>Regional traits</i>					
Population in thousand	2660	4145.17	2900.39	142.90	31988.70
Real GDP per capita in RMB at 2004 constant prices	2660	120892	160130	14738	2806818
Knowledge capital stock	2660	338	1676	3.84	37045
Patents granted per 10000 residents	2660	0.29	2.12	0	73.46
Share of students enrolled in tertiary education	2660	0.01	0.01	0	0.10
Share of finance industry employment	2660	0.04	0.02	0	0.12
Share of employment in state-owned enterprises	2660	0.70	0.23	0	1
Share of employment in privately-owned enterprises	2660	0.16	0.14	0	1
Share of employment in foreign-owned enterprises	2660	0.07	0.12	0	0.72
Relative specialization index of manufacturing	2660	36.63	60.38	3.27	1780.06
<i>Regional industrial level traits</i>					
Employment in thousand	392616	1.10	4.98	0	304.98
Share of new product in sales	162582	0.04	0.13	0	0.18
Chinitz measure of small suppliers (average firm size of supplying industries)	392616	0.01	.09	0	1
Supplier strength	392616	0.16	0.35	0	0.74
Customer strength	392616	0	0.02	0	1

Note: Unless otherwise indicated, variables are indices without units. Variables are transformed from these raw values to have unit standard deviation before estimation.

Source: Author's calculations based on the Annual Survey of Industrial Enterprises (Chinese National Bureau of Statistics 2008).

For the purpose of our research, the *ASIE* database requires substantial standardisation which includes the following steps: Identification of a unique firm ID, identification of single plant firms and exclusion of establishment expansions from our definition of new business

formation, as well as the industrial classification of the firm¹¹. After standardisation, the database contains systematic, consistent and complete firm-level information, among others, on *name, geographical location, industry, ownership*¹², *employment, industrial sales, gross output, value added, R&D expenditures, and sales with new products*. Given the regional focus of the proposed research, we assign each firm to a specific prefecture¹³ or one of four Chinese municipalities (Beijing, Chongqing, Shanghai and Tianjin) (hereafter called “prefectures” or “regions”). In order to trace the specific prefecture of a firm, a concordance scheme between Chinese two-digit zip codes, as captured by the *ASIE*, and prefectures is used.

3.2 Variables

Dependent variable

Our dependent variables are the log measure of entry rates by prefecture-industry and the new business formation count by prefecture-industry. Regarding our first measure of regional entry rates, the use of appropriate measures of firm entry is required to deal with regional differences in employment, population, and industrial structure. We use a standardised regional firm entry rate to make them comparable across regions and time (Fritsch 1992). We apply the population-ecological approach (see Fritsch 1997) and use y_{irt} as defined by the number of new businesses x_{irt} in industry i and region r divided by 100 active establishments in industry i and region r , denoted as v_{it}

$$y_{irt} = \frac{x_{irt}}{v_{it}} \cdot 100 \quad i = 1, \dots, N, r = 1, \dots, R, t = 1, \dots, T \quad (1)$$

¹¹ Each firm is classified into an industry following the 3-digit Chinese Industry Classification (CIC) system that resembles the European industry standard classification system (NACE) at the 3-digit code level. In 2003, the Chinese classification system was revised. To make the industry codes comparable across the entire period, we constructed used a harmonised classification following Brandt et al. (2012).

¹² These are state-owned enterprises, collective-owned enterprises, privately-owned enterprises, two types of foreign-owned enterprises, those from Hong Kong, Macau, and Taiwan (HMT-owned), and those from all other countries.

¹³ These include prefecture-level cities, prefecture cities and prefecture-level municipalities which are an administrative division of the People's Republic of China. They rank below the level of province and above the level of a county in China's administrative structure. Prefecture-level regions form the second level of the administrative structure and are widely viewed as the most appropriate unit for modelling and analysis purposes (see, for example, Roberts et al. 2012).

See Figure 1 in the Appendix for an overview on the spatial distribution of new business formation rates and Figure 2 for R&D-intensive new business formation rates across Chinese prefectures in the period 1998 to 2007.

For the purpose of robustness of our results, we further include log mean-employment in regional industry as well as employment in new businesses by regional industry as dependent variables.

Independent variables

We view regional stocks of knowledge capital as proxies for the state of knowledge (Fischer et al. 2009; Scherngell et al. 2014)¹⁴, created by private or public agents. Knowledge is assumed to accumulate over time and to depreciate from period to period at a constant rate δ_k ¹⁵ using the perpetual inventory method so that

$$k_{rt} = (1 - \delta_k) k_{r,t-1} + s_{r,t-1} \quad r = 1, \dots, R, t = 1, \dots, T \quad (2)$$

where knowledge production activities s in region r undertaken in period $t-1$ become productive in period t . Given this law of motion, for region r , k_{rt} represents the knowledge capital stock in period t based on previous knowledge production activities.

We measure regional knowledge stocks by corporate patent counts¹⁶ in manufacturing from all technological sectors and patent stocks are derived from the Chinese Patent Statistic Database. We do not exclude any technological sector, as i) most patents are granted in the

¹⁴ The knowledge created by a private or public agent is added to the pool of the existing knowledge capital stock to which other agents have access. Note that even if the benefits of R&D activities are fully appropriated by an agent, in the sense that an agent acquires a monopoly right by patent protection, some portion of the knowledge that has led to the patent may diffuse across regions through various communication channels such as publications, seminars, personal contacts, reverse engineering, (informal) exchange in networks, transfer of human capital and other means (Park 1995).

¹⁵ A constant 12% depreciation rate was applied for each year to the stock of patents created in earlier years. The assumption of a depreciation rate of 12% for the obsolescence of technological knowledge follows former empirical studies (see, among others, Robbins 2006).

¹⁶ Patent documents provide information on the technological, geographical and temporal location (that is, their technological class, the geocoded location of the inventor(s) and the date of application). All patent applications are assigned to the region of the address of the inventor, rather than the address of the assignee, for tracing inventive activities back to the region of knowledge production. Assignment is done by using a concordance scheme between postal codes and regions. In the case of multiple inventors the standard procedure of proportionate assignment is followed.

manufacturing sector anyway, and ii) knowledge spillovers may occur from all technological fields. Patents are direct outcomes of R&D processes. A patentable invention must be new, must involve an inventive step and must be capable of industrial application. In line with Robbins (2006), we argue that an aggregation of patents is more closely related to the regional knowledge capital stock than an aggregation of R&D expenditures. To create regional patent stocks for 1988-2007, the patents are transformed, *first*, by sorting based on the year that a patent was applied for, and, *second*, by the region where the inventor resides. In order to trace the specific region of an author, the zip codes of the author's address have been used.

We also consider the share of students being enrolled in tertiary education per 10000 residents as a regional determinant of entrepreneurship. Our results are also robust to alternative measures of the education level such as the percentage of adults aged 18 to 64 with higher secondary education.

As a third regional trait, we include measures for private as well as foreign industrial ownership structure. In detail, the share of private-owned industrial firms among all incumbent industrial firms in the prefecture measures the importance of private business in the prefecture for entrepreneurship. Likewise, the share of foreign-owned industrial firms measures the effect of the presence of foreign-owned industry, mostly Hong-Kong, Macau and Taiwan-owned firms, on entrepreneurship.

Recent evidence suggests that new business formation varies considerably across industries and our second set of independent variables serves to quantify the effects of regional industrial traits for firm entry in a particular industry. Empirical evidence suggests higher rates of NBS are to be found in industries where incumbents commercialise entrepreneurial opportunities to a lesser extent (Acs et al 2008; Braunerhjelm et al. 2010). Our first regional industrial measure is therefore the share of new product sales in overall output of incumbents as a measure for entrepreneurial opportunities in a region.

Second, we include a measure to capture the extent to which prefectures contain potential customers and suppliers for a new entrepreneur using input-output tables for China developed by the Chinese Statistical Agency. This measure captures the idea of input-output backward and forward linkages between firms and sectors as source of agglomeration economies

(Krugman 1992). We define $c_{i \leftarrow k}$ as the share of industry i 's input that comes from industry k , and $s_{i \rightarrow k}$ as the share of industry i 's output that goes to industry k . These measures run from zero (indicating no customer or supplier purchasing relationship) to one (full dependency on the paired industry). To capture the relative strength of supplier relationships in a prefecture, we define the measure supplier strength s_{ir} of industry i in prefecture r as

$$s_{ir} = \sum_{k=1}^M \frac{e_{rk}}{e_k} s_{i \rightarrow k} \quad i = 1, \dots, N, r = 1, \dots, R \quad (3)$$

where e_k is the national employment in industry k and e_{rk} the regional employment in industry k . The ratio e_{rk}/e_k is then the location quotient indicating the relative specialisation of a prefecture in industry k . We multiply this location quotient with our share $s_{i \rightarrow k}$ of industry i 's output that goes to industry k , which tells us the national share of industry i 's output sales that go to industry k with the relative specialisation of industry k in prefecture r . By summation across industries, we take a weighted average of the supplier strength of regional industrial supplier purchasing relationship for industry i in prefecture r . Our measure for supplier strength takes on higher values with greater supplier purchasing opportunities. Accordingly, we define customer strength c_{ir} of industry i in region r as

$$c_{ir} = \sum_{k=1}^M \frac{e_{rk}}{e_k} c_{i \leftarrow k} \quad i = 1, \dots, N, r = 1, \dots, R \quad (4)$$

which is the national share of industry i 's input purchases that come from industry k multiplied by the relative specialisation of industry k in prefecture r . By summation across industries, we take a weighted average of the customer strength of regional industrial customer purchasing relationship for industry i in prefecture r . Our measure for customer strength takes on higher values with greater customer purchasing opportunities.

As a third regional industrial trait, we include a measure for the presence of small suppliers. We quantify this so-called Chinitz (1961) effect s_{ir}^* for industry i in prefecture r as follows

$$s_{ir}^* = \sum_{k=1}^M \frac{f_{rk}}{e_{rk}} s_{i \leftarrow k} \quad i = 1, \dots, N, r = 1, \dots, R \quad (5)$$

where f_{rk} is the number of incumbent firms in industry k in prefecture r and e_{rk} is overall the employment of industry k in region r . The ratio tells us the average firm size in industry k in prefecture r . We multiply the average firm size by our measure of supplier strength, which tells us the average firm size in a prefecture in industries that typically supply our industry i . Higher values of our Chinitz measure indicate higher shares of small suppliers.

Control variables

In line with recent studies, we control for regional population size and per capita income to account for differences in levels of economic activity and size between Chinese prefectures. Beyond these basic demographic regional traits, we also control for the strength of the banking environment by the share of employment in the finance industry in overall regional employment. Thereby, we control for the presence of regional institutions that provide access to banking credit in China. As information asymmetries lead to imperfections in markets for loans, with face-to-face contact between local lender and creditor substituting national markets, literature suggests variation in funding of riskier knowledge investment across regions (Fritsch and Schilder 2008).

In line with literature on regional determinants of new business formation, we also control for the relative specialisation of manufacturing employment in industry i and region r using the relative specialisation index. Our results on the effects of manufacturing specialisation are robust to different measures such as the inverse Hirschmann-Herfindahl index as well as the Theil index.

In order to control for general industrial traits that are specific to a region, we include the overall employment in a prefecture-industry for incumbent firms. This measure is important given that entrepreneurs often leave incumbents to start their companies and the bigger the pool of incumbent employment the higher the entrepreneurial opportunities (Klepper 2010).

3.3 Empirical model

We aim to quantify the effects of theoretically derived regional traits and regional industrial traits on new business formation counts as well as NBF rates in China. To address this question, we *first* model the NBF rate \mathbf{y}_{irt} of industry i in region r at time period t using ordinary least squares regression techniques to examine how industrial and regional traits explain the variation in entry rates across China. The analysis of entrepreneurship at the regional industry level allows us to quantify the effects of both prefecture-level determinants and the underlying heterogeneity for entrants across industries due to incumbent industrial structures. Our basic empirical model takes the form

$$\mathbf{y}_{irt} = \alpha \mathbf{X}_{rt} + \beta \mathbf{Z}_{irt} + \mu_i + \tau_r + \varepsilon_{irt} \quad i = 1, \dots, N, r = 1, \dots, R, t = 1, \dots, T \quad (6)$$

where our dependent variable \mathbf{y}_{irt} is the log measure of entry rates by prefecture-industry. It is important to note that we follow Glaeser and Kerr (2009) as well as Ghani et al. (2014) and recode a value of less than one firm entry on average as one firm entry¹⁷. Our sample includes the prefecture-industry observations in which positive incumbent employment exists. \mathbf{X}_{rt} is a vector of our regional traits, among others, knowledge stock, share of employment in privately-owned firms and share of employment in foreign-owned firms. \mathbf{Z}_{irt} is a vector of regional industrial traits related to, among others, new product intensity, and customer and supplier strength. Many of our explanatory variables, such as prefecture population or prefecture-industry employment, are also in log values so that the coefficients estimate elasticities or proportionate responses. We transform our constructed indices that are non-log measures to have unit standard deviation for interpretation. ε_{irt} is an independently and identically distributed (i.i.d.) error term with zero mean and variance σ^2 , while μ_i denotes a region fixed effects and τ_r industry fixed effects. The fixed effects estimation tells us how much of the unexplained organisational variation of new firm entry rates can be explained through industrial and regional conditions that are especially suitable for firm entry. Further, we use cluster standard errors by prefecture to reflect the multiple mappings of prefecture-level variables across regional industries.

¹⁷ It is important to point out that roughly 68% of our regional industry NBF observations are zero. We believe that the distinction between one and zero firm entry is not economically meaningful and does not impact the consistency of our sample size. However, the estimates of our model using OLS regression with fixed effects have to be read with caution and in relation to the Poisson regression estimates which does include zero observations.

Given the micro-level perspective of this study, we encounter firm entry and exit distributions that are highly skewed and include a high share of zero observation which we have account for in our estimation strategy. Therefore, and for the purpose of robustness, we also model the new business formation count y_{irt}^* of industry i in region r at time period t using a Poisson regression specification and maximum likelihood estimation. This is done in order to examine how industrial and regional traits explain the variation in entry counts across China. Since our count measure does not account for regional differences in size of incumbent firm population, we include the number of incumbent firms in the prefecture-industry to control for these differences.

4. Results

In Table 2 we present the main OLS regression estimates. The observations are prefecture-industry pairs. The results in column (i) to (iii) provide results for the sample of non-R&D intensive firms (with R&D expenditures below 3 percent of sales output), while those in column (iv) to (vi) provide results for the R&D-intensive firm sample. We provide results for three different variants of our main empirical specification: For all two subsets, we test (i) a basic specification with general regional and regional industrial traits only; (ii) the full specification; and (iii) a full specification using employment in new businesses instead of NBF rates.

Column (i) and (iv) include prefecture population, real GDP per capita, prefecture-industry employment and fixed effects. The incumbent prefecture-industry employment strongly shapes firm entry for non-R&D businesses. An increase of 10% in prefecture-industry employment leads to a 2% increase in firm entry rates, which is in line with an estimated effect of around 2% for India (Ghani et al. 2014) and 7% for the U.S. (Glaeser and Kerr 2009). The adjusted R-squared value for this estimation is 0.28. However, prefecture-industry employment does not explain R&D-intensive firm entry which is rather related to the level of real GDP per capita. Here, an increase of 10% in prefecture GDP per capita is associated with an increase of 1% in R&D-intensive new business formation rates.

Table 2: OLS regression results for new business formation rates

	All firms			R&D-intensive firms		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
<i>Regional traits</i>						
Log population	0.019 (0.090)	0.153 (0.131)	0.117 (0.147)	0.010 (0.020)	-0.018 (0.022)	-0.014 (0.022)
Log real GDP per capita	0.085 (0.061)	0.114 (0.108)	0.018 (0.092)	0.009 ^{***} (0.004)	-0.001 (0.007)	0.001 (0.009)
Log knowledge capital stock		-0.027 (0.043)	-0.139 ^{***} (0.052)		0.015 ^{***} (0.001)	0.018 ^{**} (0.009)
Share of students in tertiary education		0.044 (0.038)	0.036 (0.037)		0.012 ^{***} (0.003)	0.015 ^{***} (0.004)
Share of employment in finance		-0.003 (0.021)	0.022 (0.023)		0.004 (0.009)	0.002 (0.010)
Share of employment in privately-owned firms		0.294 ^{***} (0.032)	0.267 ^{***} (0.035)		0.007 (0.004)	0.014 ^{**} (0.006)
Share of employment in foreign-owned firms		0.131 ^{**} (0.045)	0.195 ^{***} (0.051)		-0.010 (0.008)	-0.009 (0.010)
Relative specialisation index of mfg. employment		0.081 ^{***} (0.010)	0.054 ^{***} (0.010)		0.001 (0.001)	-0.002 (0.002)
<i>Regional industrial traits</i>						
Log employment	0.210 ^{***} (0.004)	0.200 ^{***} (0.013)	0.311 ^{***} (0.014)	0.003 ^{***} (0.000)	0.003 ^{***} (0.001)	0.004 ^{***} (0.002)
New product intensity		-0.031 ^{***} (0.005)	-0.055 ^{***} (0.007)		-0.008 ^{***} (0.001)	-0.011 ^{***} (0.001)
Chinitz measure of small suppliers		-0.155 ^{***} (0.021)	-0.121 ^{***} (0.021)		-0.002 ^{***} (0.000)	-0.004 ^{***} (0.001)
Supplier strength measure		1.164 ^{***} (0.132)	-0.133 (0.209)		0.031 ^{***} (0.011)	0.052 ^{***} (0.019)
Customer strength measure		1.338 ^{***} (0.143)	-0.149 (0.228)		0.035 ^{***} (0.012)	0.058 ^{***} (0.021)
N	392616	161626	161626	392616	161626	161626
Σ	0.19	0.34	0.41	0.01	0.02	0.04
P	0.03	0.04	0.03	0.01	0.01	0.01
Adjusted R ²	0.28	0.20	0.12	0.03	0.06	0.06
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Estimations consider (i – ii) gross new business formation rates and (iii) mean employment in new businesses for regional industry as dependent variables. OLS regression estimations report standard errors clustered by prefecture. The variables *new product intensity*, *share of students in tertiary education*, *share of employment in finance*, *share of privately-owned firms*, *share of foreign-owned firms*, *relative specialisation index of manufacturing*, *Chinitz measure of small suppliers*, *supplier strength* and *customer strength measure* are transformed to have one unit standard deviation for interpretation.

However, while Ghani et al. (2014) estimate a related specification for India, Glaeser and Kerr (2009) use long-term employment for a city-industry as the key explanatory variable. While the elasticity for India is comparable, as is the R-squared value for India, the elasticity of 7% with an adjusted R squared of 0.80 as reported Glaeser and Kerr (2009) is higher for the U.S. Although differences between the Chinese, Indian and U.S. data limit perfect comparison, we believe that the datasets are sufficiently similar to make some basic inference. Most importantly, while existing regional industry employment explains the similarity of spatial distribution of firm entry in China, India and the U.S., China has nonetheless a distinct regional pattern of entrepreneurship as shown by our empirical findings below.

Columns (ii) and (v) introduce regional and regional industrial traits: knowledge capital stock, tertiary education level, finance, and industrial ownership structure of the region are the central regional determinants of interest. Somehow surprisingly, our measures of basic demographic regional traits do not play a role in firm entry across China. Regional population size and per capita income have a positive coefficient but are not significant. The only exception is per capita GDP income in our R&D-intensive sample, where we observe a significant positive coefficient. However, the coefficient is economically not meaningful.

Beyond these basic demographic regional traits, our results show the importance of knowledge capital stocks and share of students in tertiary education for R&D-intensive firm entry. Prefectures that have a 1% higher knowledge capital stock or a 1% higher share of students in tertiary education display on average a 1-2% higher R&D-intensive firm entry rate. In contrast, these measures of the regional knowledge-economy do not display positive associations with non-R&D-intensive firm entry. In line with our hypothesis, we thus conclude that our different firm samples differ in their requirement of local knowledge and human capital. Our estimates are robust with regard to different measures of knowledge capital and human capital, notably patents granted and population with secondary education attainment, as well as the use of mean-employment in new businesses as dependent variable.

In contrast to knowledge capital, the share of employment in finance does not find support in our estimates. The impact of a higher finance share on firm entry is negligible and not significant. This result is in line with the findings of Ghani et al. (2014) for organised

manufacturing in India. They report a positive, but statistically not significant effect of the strength of the household banking environment on manufacturing firm entry.

A higher share of employment in privately-owned enterprises is found to have a positive and robust effect on non-R&D-intensive firm entry. A 10% increase in the share of private employment as compared to the mean leads to a 29% increase in firm entry. We conclude that a positive relationship for private entrepreneurship exists with our non-R&D-intensive manufacturing entry measures. Future work will hopefully further clarify the mechanisms of how the presence of private firms in China affects new firm entry. In contrast, our results suggest that R&D-intensive firm entry does not depend on a higher private industry presence in the prefecture.

Similarly, the effect of foreign industry ownership on non-R&D firm entry is positive with an elasticity of 13% which is half the size of the impact of domestic private ownership. Again, as with privately-owned firm, R&D-intensive new business formation is not significantly affected by the presence of foreign-owned firms. It is important to point out that our results are in line with recent evidence on the negative effect of foreign ownership on technological change as reported by Zhou et al. (2011). In their study on determinants of the ICT sector's labour productivity, exports and revenues from new products they find a strong and persistent negative spatial association between technological investment and regional specialization in foreign-owned and export-led industries. ICT firms in Beijing, which is the most domestic-oriented region, outperform Shanghai-Suzhou and Dongguan-Shenzhen on all three measures of technological dynamism.

We also control for the effect of prefecture specialisation in manufacturing activities on manufacturing firm entry. Our results reveal a differential impact of specialisation on firm entry with non-R&D-intensive new business formation being positively related to higher values of prefecture specialisation. R&D-intensive entrepreneurship, however, is not driven by manufacturing specialisation.

Regarding regional industrial traits, two factors stand out as hampering new firm entry. First, and in line with our hypothesis, new product intensity is negatively correlated with firm entry. While an increase of 1% in new product intensity of the regional industry leads to a decrease

of 3% in non-R&D-intensive firm entry, the effect is weaker for R&D-intensive NBF with an elasticity of 1%. Thus, new firms do rather enter regional industries with lower new product intensities. In this regard, evidence for China suggests a similar pattern to industrialised countries where higher rates of NBF are to be found in industries where incumbents commercialise entrepreneurial opportunities to a lesser extent (Acs et al 2008; Braunerhjelm et al. 2010).

Second, NBF is negatively associated with our Chinitz measure of the presence of small suppliers in the prefecture-industry. In particular, non-R&D-intensive firm entry decreases by 16% in prefecture-industries with a presence of small suppliers that is 10% higher than the mean. This observation stands in contrast to evidence for India (Ghani et al. 2014) and the U.S. (Glaeser and Kerr 2009) where positive elasticities of 0.28 and 0.38 were found, respectively.

Further, columns (ii) and (v) show that supplier and customer markets are regional industrial traits that enhance non-R&D-intensive firm entry. The coefficients are 1.2 and 1.3, both being statistically significant and economically important. The input and output market explanatory power is substantially greater than our other determinants. However, the effects of input and output markets are considerably weaker on R&D-intensive new business formation. Here, the explanatory power is comparable in size to knowledge capital stock and the share of students in tertiary education as main determinants of R&D-intensive firm entry. This suggests that R&D-intensive firm entry does not require local intermediate demand conditions to the same degree as non-R&D-intensive entry.

In order to test for robustness of our results, we first estimated our empirical model within our OLS regression estimation framework using mean-employment in new businesses as our dependent variable. Columns (iii) and (vi) show the results for our non-R&D-intensive and R&D-intensive sample, respectively. In general, our results support our findings. However, it is important to point out that the coefficients of our supplier and customer strength measures are not positive and statistically significant any more for our non-R&D-intensive sample. These elasticities were among the highest for our standard model estimation.

Second, we conduct an empirical analysis of our sample using a Poisson regression estimation framework. We have opted for a Poisson specification because our dependent variable follows a Poisson distribution with approximately 68% or zero observation. As stated above, we believe that the distinction between one and zero firm entry is not economically meaningful. However, the inclusion of these zero observations is important when we want to account for actor's decision not to start a new venture in a given prefecture.

Table 3 show our results for the Poisson regression. Again, our observations are prefecture-industry pairs. The results in column (i) to (iii) provide results for the sample of non-R&D intensive firms and those in column (iv) to (vi) provide results for the R&D-intensive firm sample. We provide results for three different variants of our main empirical specification: For all two subsets, we test (i) a basic specification with general regional and regional industrial traits only; (ii) the full specification; and (iii) a full specification using employment counts in new businesses instead of NBF counts. In contrast to the OLS specification, we include the number of incumbent firms in a regional industry to control for differences in regional industry size.

In general, the results obtained support our conclusion so far regarding the importance of knowledge capital stock, education level of the population, domestic industrial ownership structure, new product intensity, as well as local intermediate demand conditions for firm entry.

However, in contrast to our OLS estimates, column (ii) and (v) show that incumbent prefecture-industry employment is not economically meaningful for firm entry. Nonetheless, the coefficients remain statistically significant. Likewise, R&D-intensive firm entry is negatively correlated with prefecture population as opposed to our non-R&D-intensive firm sample. The size of the regional population and the regional industry employment as approximations of entrepreneurial potential thus do not explain R&D-intensive entrepreneurship. These measures are positively associated with our non-R&D firm sample but the coefficients are not economically significant.

Table 3: Poisson regression results for new business formation counts

	All industrial firms			R&D-intensive industrial firms		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
<i>Regional traits</i>						
Population	0.000 (0.001)	0.001*** (0.001)	0.001** (0.000)	-0.005* (0.003)	-0.007** (0.003)	-0.004 (0.004)
Real GDP per capita	0.000** (0.000)	0.000*** (0.00)	0.000*** (0.000)	0.000 (0.000)	0.000* (0.000)	0.000* (0.000)
Knowledge capital stock		-0.010 (0.007)	-0.012*** (0.004)		0.125*** (0.033)	-0.050 (0.058)
Share of students in tertiary education		-0.045 (0.054)	-0.058 (0.046)		0.216** (0.094)	-0.013 (0.017)
Share of employment in finance		-0.033 (0.032)	-0.051* (0.027)		-0.072 (0.104)	-0.216 (0.132)
Share of employment in privately-owned firms		0.340*** (0.052)	0.225*** (0.053)		0.323** (0.130)	0.563*** (0.211)
Share of employment in foreign-owned firms		-0.158 (0.196)	-0.001 (0.099)		-0.500 (0.739)	-0.528 (0.412)
Relative specialisation index of mfg. employment		0.014 (0.027)	-0.138** (0.069)		0.011 (0.035)	-0.103 (0.141)
<i>Regional industrial traits</i>						
Employment	0.000*** (0.000)	0.000*** (0.000)	0.000* (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000** (0.000)
Number of incumbent firms	0.004*** (0.001)	0.004*** (0.000)	0.001** (0.000)	0.003*** (0.001)	0.002*** (0.001)	0.001 (0.001)
New product intensity		-0.030*** (0.006)	-0.059 (0.009)		0.003 (0.058)	-0.149* (0.081)
Chinitz measure of small suppliers		-1.701*** (0.097)	-0.327*** (0.040)		-0.821*** (0.273)	-0.091* (0.051)
Supplier strength measure		5.433*** (0.081)	6.481*** (0.081)		4.024*** (0.263)	6.717*** (0.457)
Customer strength measure		6.069*** (0.083)	7.171*** (0.083)		4.555*** (0.283)	7.439*** (0.489)
N	392616	161626	161626	286344	131526	131526
Log-likelihood	-387580	-215951	-2731015	-6011	-4766	-1093156
AIC	-775510	-432273	-5460000	-12373	-9903	-2186682
BIC	-777414	-434122	-5460000	-14221	-11713	-2188493
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Coefficients reported are the expected increase in *log* count for a one-unit increase in the independent variable. Estimations consider (i-ii) gross new business formation counts and (iii) employment in new businesses for regional industry as dependent variable. Poisson regression estimations report robust standard errors (Cameron and Trivedi 2009). The variables *new product intensity*, *share of students in tertiary education*, *share of employment in finance*, *share of privately-owned firms*, *share of foreign-owned firms*, *relative specialisation index of manufacturing*, *Chinitz measure of small suppliers*, *supplier strength* and *customer strength measure* are transformed to have one unit standard deviation for interpretation

On the one hand, and in contrast to our OLS estimates, the effect of a higher share of employment in privately-owned firms on R&D-intensive firm entry is positive. While our OLS estimates do not report a significant coefficient, the Poisson estimates rather suggest a positive and significant impact of private industry ownership on R&D-intensive new business formation. Moreover, the use of mean-employment in new businesses as dependent variable and Poisson regression estimates in Table 3 confirms the positive relationship between firm entry and private ownership across Chinese prefectures.

On the other hand, the effect of foreign industry ownership on firm entry is ambiguous. The Poisson estimates do not support our results in Table 2 of a positive relationship between a higher presence of foreign ownership and firm entry. In fact, we do report estimates that are not statistically significant for both samples.

Strikingly, the effects of supplier and customer strength on firm entry stand out in magnitude among our variables tested. This confirms the importance of local demand conditions for entrepreneurship in China in line with results reported for India and the U.S. (Ghania et al 2014; Glaeser and Kerr 2009). However, our OLS estimates for our R&D-intensive sample show that the effects of supplier and customer market strength on firm entry is double as strong as the impacts of knowledge capital stock and share of students in tertiary education. Therefore, our Poisson estimates point to a stronger role of customer and supplier strength on R&D-intensive entry. In detail, a one-unit increase in the customer strength measure leads to an expected increase in the NBF log count of 4.5, or alternatively of 90 NBF counts. Also, a one-unit increase in supplier strength is associated with an increase in R&D-intensive counts of 55.

We conclude that the use of employment rather than firm count and the Poisson regression estimates do not substantively affect the results presented. We obtain similar and robust results regarding the independent variables that are related to three of our four hypotheses, namely knowledge capital stock, new product intensity, and customer-supplier relationships. The effect of our measure for private ownership is more ambiguous for our R&D-intensive sample. However, concerning non-R&D-intensive new business formation, the positive effect of the share of privately-owned firms is robust.

5. Summary and concluding remarks

China has a rich entrepreneurial history. During the first decades of Communist rule, this Chinese tradition has been almost distinguished. Today, new firm entry has been recognised by the Chinese leadership as central for economic growth and the restructuring of the economy towards more private initiative. In particular, new technology-based firms are seen a source for future innovation-led growth.

However, the factors enabling or hindering new business formation are not well understood yet in the Chinese context. This question is of uttermost importance for China given its strategic goal of inducing innovation-led growth and nurturing new high-tech sectors. Using a rich database on industrial establishments in China and applying panel data modelling techniques, this study set out to empirically assess the impact of regional and industrial traits on new business formation across Chinese prefectures. By this, we provide important insights into similarities and differences in regional patterns of entrepreneurship across China. In doing so, our analysis provides important evidence on what drives and hinders regional new firm entry, both for Chinese policymakers as well as a guide for future research.

The empirical findings are promising and of great interest in comparison to actual related empirical works on Indian and U.S. regional entrepreneurship. *First*, our results suggest marked differences in entrepreneurial patterns between China, India and the U.S. While empirical evidence for India, which is also an emerging economy, shows the importance of banking and the presence of small suppliers for regional firm entry, our results rather do not support this finding for China. However, as in the Indian case, the local demand conditions as approximated through customer-supplier relationships, as well as the education level of the population have been found to exert a positive influence on regional firm entry. This evidence on local agglomeration economies and entrepreneurship is the first for China and among the first ones for an emerging economy.

Second, this study for the first time compared regional determinants of not only new firm formation, but also differentiated between R&D-intensive and non-R&D-intensive firms. Our results point to differences in entrepreneurial patterns between R&D-intensive firms and non-R&D-intensive firms. While regional knowledge capital stocks in general do not play a significant role on firm entry in China, they were found to be a driver of R&D-intensive new

business formation. Strikingly, knowledge capital stocks are in terms of their impact on entry comparable to the effects of the share of students in tertiary education and customer-supplier relationships. In this respect, the results contradict scepticisms that the Chinese investment in R&D is not related to industrial upgrading and commercialisation. Indeed, significant STI policy efforts that have been implemented in the 1990s seem to have come into effect after 1998.

Third, this is the first study – to the authors’ knowledge – that gives systematic evidence on the spatial pattern of industrial firm entry, putting special emphasis to R&D-intensive manufacturing firm entry, across Chinese prefectures. Our results confirm the importance of differences in industrial ownership structure for new business formation rates across prefectures. Interestingly, entry rates are higher in prefectures and municipalities with above average private sector ownership of industry. However, the relationship between private ownership and new R&D-intensive firms is not robust. What is even more striking is the negative association found between the share of foreign-owned firms and firm entry. Our results thus point to the importance of domestic ownership structure for overall firm entry.

We are able to provide evidence for our hypothesis. We confirm that R&D-intensive new business formation rates are higher in prefectures with higher levels of patent stocks. Further, we show that new business formation rates are higher in regional industries with lower share of new product sales in output sales of incumbent firms. We also provide evidence for our assumption that new business formation rates are higher in prefectures with a higher share of private ownership of the incumbent industry. Finally, our results support our hypothesis that firm entry rates are higher in prefectures with higher levels of supplier-customer relationships.

Some ideas for a future research agenda come to mind. Further work needs to be done to understand the role of public research policy for R&D-intensive firm entry. Our results point to a positive impact of knowledge capital stock, which is to a large degree publicly funded in China. In this context, the interaction between public R&D investment and private networks of entrepreneurial action should be further analysed systematically for China in order to gain insight into the overall impact of public research outcomes and the way they are commercialised on China's growth. By this, we might gain important insights into China’s efforts to transform towards a high-income country. Also, further research surrounding the

time dimensions including the use of dynamic panel data models to better understand the effect of entrepreneurship on structural change might be particularly attractive given the rapid pace of the China's transformation.

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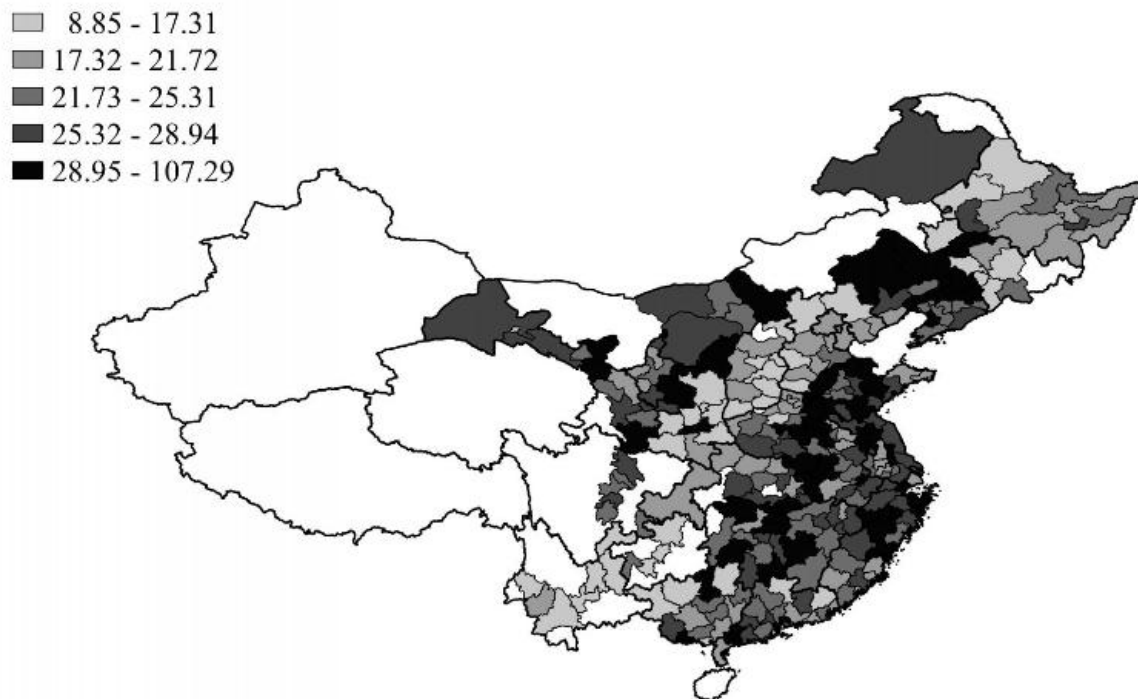
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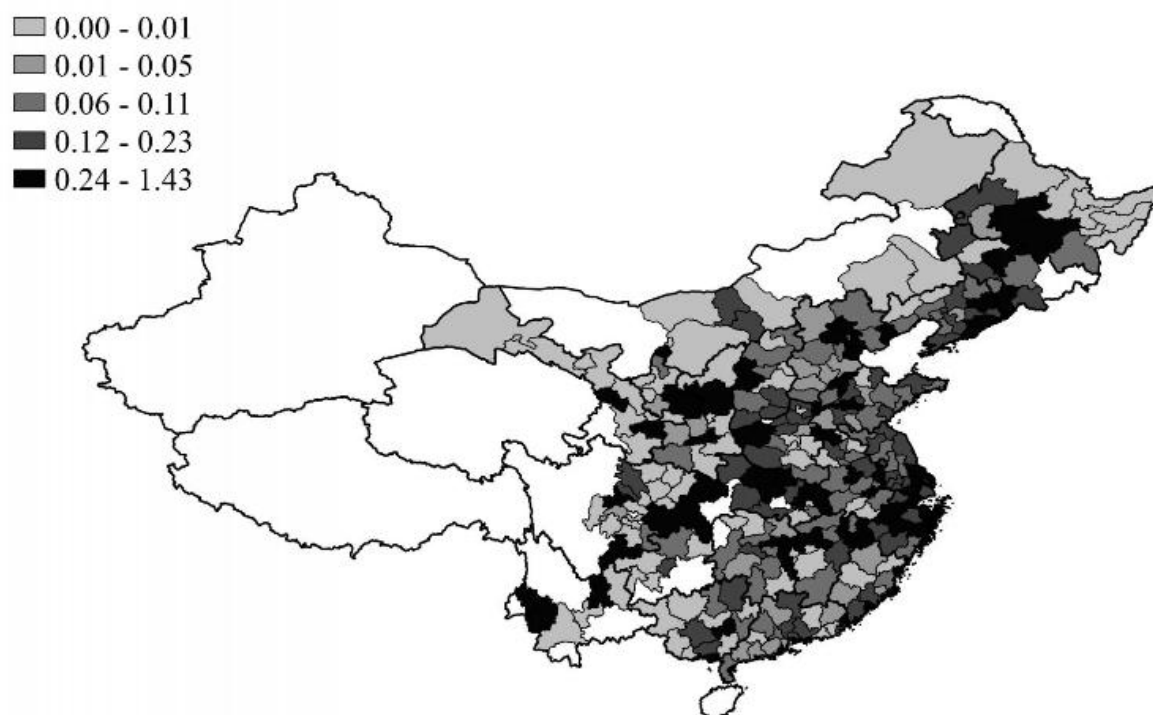
Appendix

Figure 1: Number of new businesses per 100 active establishments, average 1998 - 2007



Note: Prefectures and provinces in white show missing values.
Source: Own illustration.

Figure 2: Number of new R&D-intensive businesses per 100 active establishments, average 1998 - 2007



Note: Prefectures and provinces in white show missing values.
Source: Own illustration.