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How Does Agglomeration Promote the Product Innovation of Chinese Firms?*

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Abstract

This study empirically analyzes the effect of agglomeration economies on firm-level product innovation (new products), using Chinese firm-level data from 1998 to 2007. In terms of new product introduction and new product output, Chinese firms benefit from urbanization economies (as measured by the number of workers in other industries in the same city and by the diversity of industries in the same city). Conversely, there were no positive effects of localization economies (as measured by the number of other workers working for neighboring firms in the same industry and in the same city). These results suggest that, in China, urbanization economies play an important role in fostering product innovation by urban size and diversity.

Keywords: Agglomeration economies, Localization economies, Urbanization economies, Product innovation, New products
JEL classification: O14, R11

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1. Introduction

China has had impressive industrialization and economic growth along with its economic reform over the last three decades. During this process, industrial agglomeration has increased steadily and consistently (Wen, 2004; Ge, 2009; Lu and Tao, 2009). Moreover, Chinese firms enjoy an increase in innovative output in terms of total factor productivity (TFP), the ratio of new product sales to total sales, and patent applications(Jefferson et al., 2004; Jefferson et al., 2006; Brandt et al., 2011). Agglomeration economies are generally assumed to improve productivity and spur innovation of firms through localization economies and urbanization economies.[1] In particular, localization of economies, as proposed by Marshall (1890), indicates that concentration of an industry in a given area generates positive externalities on input markets, labor markets, or knowledge exchange. Glaeser et al. (1992) suggest that the concentration of an industry in a city promotes knowledge spillovers between firms and that such concentration would therefore facilitate innovation in that city-industry observation. An important assumption is that knowledge externalities to firms exist only for firms within the same industry. By contrast, urbanization economies, as emphasized by Jacobs (1969), imply that industrial diversity in a city facilitates the transmission of technology and knowledge of different industries, and thus creating new knowledge and technology. Jacobs focuses on inter-industry knowledge spillovers and argues that diversity rather than specialization promote innovative activity and economic growth. This gives rise to the following research questions. Does agglomeration account for innovative output (termed as new product in this paper) in developing countries such as China? If it does, how do innovation activities of Chinese firms benefit from agglomeration economies, from localization economies, and/or from urbanization economies?

There is a large empirical literature investigating the effect of localization and urbanization on productivity.[2] Despite its economic importance, there are few empirical studies focusing on agglomeration and firms' product innovation. Feldman and Audretsch (1999) and De Beule and Van Beveren (2010) are two of the few exceptions. Feldman and Audretsch find a tendency for innovative activity in complementary industries sharing a common science-base to cluster together in a city. The diversity has a strong positive effect and specialization a negative one, on

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[1] In some related literatures, localization is also referred as specialization and urbanization is referred as diversity. This paper uses these terms interchangeably.

[2] For example, Henderson (2003) and Martin et al. (2011) investigate the relative effects of localization economies and urbanization on plant or firm-level TFP in the United States and France, respectively.

new product introductions reported by trade journals in the United States. De Beule and Van Beveren (2010) find a positive impact of own-industry employment concentration on the product innovation of Belgium firms. However, they consider localization only. Recent theoretical work by Duranton and Puga (2001) provides micro-foundations for the link between diversity and innovation. They argue that diversified cities can play a role in the development of new products and show that firms can benefit from innovations by locating in diversified cities.[3]

The purpose of this study is to investigate whether and how localization or urbanization promotes product innovation. I rely upon a direct measure of innovative output (new product) rather than on a measure of intermediate output, such as patented inventions,[4] and I consider that the indicator of new product reflects the direct contribution of research and development (R&D) output to economic growth of China. I utilize Chinese firm panel data for manufacturing industries, with yearly observations from 1998 to 2007. I first regress the new product firm dummy on firm characteristics and agglomeration variables (both localization economies and urbanization economies) controlling for firm fixed effects. I find that both the size and diversity of neighboring industries promote the introduction of new products. Then I employ the Tobit model to regress another product innovation variable, new product output, on the agglomeration variables. The estimation results show that the new product output of firms also benefits from urbanization economies rather than localization economies. As there are no previous studies investigating the effects of agglomeration on the product innovation of Chinese firms, this paper presents the first evidence of the manner in which urbanization economies affect product innovation (new products). The results remain robust to using subsamples, alternative variables, and panel estimation methods.

This study is related to the emerging literature on agglomeration and firm performance in China. For example, Lin et al. (2011) and Yang et al. (2013) find localization has positive effects on firm-level productivity of the textile industry and the electronics industry. Long and Zhang (2011) argue industrial proximity contributes to the performance (credit constraint, productivity, and export) of small firms within industrial clusters at the county level. Furthermore, Li et al. (2012)

[3] Duranton and Puga (2001) also argue that when the product become mature, firms switch to mass production and relocate to specialized cities where production costs are lower. The issue of product cycles and relocations across cities goes beyond the scope of this study.

[4] Griliches (1990) warns that the number of patented inventions is not the equivalent of a direct measure of innovative output since not all innovations are patented.

and Ito et al. (2013) investigate the effects of industrial agglomeration on firm size and export entry, respectively. The focus of this study is on the effects of agglomeration (both localization and urbanization) on product innovation, and its findings in this regard have important policy implications.

The paper proceeds as follows. In the next section, I discuss the data and variables. In Section 3, I report the main empirical findings. Section 4 concludes with some policy implications.

2. Data and variables

2.1 The Data

The data set for this study comes from the Annual Surveys of Industrial Firms (ASIF) conducted by China's National Bureau of Statistics (NBS) for the period from 1998 to 2007. The survey includes all industrial firms that are state-owned, or non-state owned firms with sales above 5 million RMB. Industry is defined here to include mining, manufacturing, and public utilities. For this study's analysis, I focus on manufacturing firms only.[5]

This study requires precise location information for the sample firms. The data set provides information on the address and regional codes of each firm. During the sample period, however, the administrative boundaries and its city codes experienced some changes. New cities might have been established, while existing cities might have been combined into larger ones. Therefore, the city codes may not be comparable across years. To address these problems, using the 1999 National Standard (promulgated at the end of 1998 and named GB/T 2260-1999) as the benchmark codes, I convert the city codes of all the firms to these benchmark codes to achieve consistency for the city codes in the whole sample period.[6]

Aside from firm location, this analysis also requires information on firms' industry classification in order to construct variables for agglomeration. Each firm is classified into an industry following the 4-digit Chinese Industry Classification (CIC) system. However, in 2003, a new classification system for industry codes (GB/T 4754-2002) was adopted to replace the old classification system (GB/T 4754-1994). The new classification system was revised to incorporate more details for some sectors, while some other sectors were merged. To make the industry codes comparable across the entire period (1998–2007), I use a harmonized classification

[5] Within manufacturing industries, I also exclude the tobacco industry into which firms' entry is strictly regulated.
[6] See Lu and Tao (2009) for details.

that groups some industries prior to and after the revision. [7] Industrial agglomeration can then be measured at the 2-digit industry level.

Some observations lack sufficient data to calculate productivity and to include in the regressions. I drop firms that have missing, zero, or negative values for fixed assets, value added, intermediate inputs, and output since the logarithms of these variables are not defined. As in Brandt et al. (2011), I treat employment similarly and drop firms with less than eight employees. The number of observations before and after these procedures is reported in the Appendix. I deflate output, new product output, value-added by output deflator, and intermediate inputs by the input deflator provided by Brandt et al. (2011). For capital stock, the NBS data report only the original value of fixed asset (OVFS) and the net value of fixed asset (NVFS). OVFS is the total capital stock at original purchase prices, while NVFS is OVFS less accumulated depreciation. Thus, OVFS and NVFS are nominal values from different years and cannot be used directly as measures of the capital stock. To construct firm capital stock series correctly, I adopt the recent estimation method proposed by Brandt et al. (2011). In particular, I first estimate the firms' initial capital stock using information from its founding year. Then I use the firm's annual investment and assumed depreciation rates to calculate its real capital stock in each year.

2.2 Agglomeration variables

I follow Martin et al. (2011) to construct variables for agglomeration economies at the 2-digit industry-city level. Specifically, I use the firm-level Annual Surveys of Industrial Firms and calculate the number of workers by year, 2-digit industry, and city. The key explanatory variables are localization economies and urbanization economies, corresponding to the two aspects of agglomeration economies.

For firm *f*, in industry *i*, city *c*, and year *t*, I measure the degree of localization economies by computing the number of other employees working for neighboring firms in the same industry and in the same city. Specifically, it takes the following form:

$$localization_{ft}^{ic} = \ln(E_t^{ic} - E_{ft}^{ic} + 1) \tag{1}$$

[7] The concordance table is constructed by Brandt et al. (2011) and available at http://www.econ.kuleuven.be/public/N07057/CHINA/appendix/

where E_t^{ic} is the total employment in industry *i*, in city *c*, and year *t*; E_{ft}^{ic} is the employment of firm *f* in the same industry, in the same city, and year. Note that this variable is firm-specific in the same industry and in the same city; therefore, it implies that the effect of local knowledge externalities to firms may be heterogeneous.[8]

I use two variables to capture urbanization economies. The first is the number of workers in other industries (the size of neighboring industries) in the same city where firm *f* is located. The second is a diversity index of industrial environment (the diversity of neighboring industries) faced by firms of industry *i*, city *c*, and year *t*. Specifically,

$$urbanization\_size_t^{ic} = \ln(E_t^c - E_t^{ic} + 1) \tag{2}$$

$$urbanization\_diversity_t^{ic} = \ln\left(\frac{1}{H_t^{ic}}\right), \quad H_t^{ic} = \sum_{i' \neq i}\left(\frac{E_t^{i'c}}{E_t^c - E_t^{ic}}\right)^2 \tag{3}$$

where E_t^c is the total employment of city *c*. A higher value of diversity implies a greater extent of diversity.

I also add a final variable in the regressions to control for the local strength of competitive pressure in line with Martin et al. (2011). The degree of competition is measured by a Herfindahl index of employment concentration inside industry *i* and city *c*. Specifically,

$$competition_t^{ic} = \ln\left(\frac{1}{Herf_t^{ic}}\right), \quad Herf_t^{ic} = \sum_{f \in S_t^{ic}}\left(\frac{E_{ft}^{ic}}{E_t^{ic}}\right)^2 \tag{4}$$

where S_t^{ic} is the set of firms belonging to industry *i* in city *c* and year *t*.

Figure 1 show the distribution of agglomeration variables described above. The

[8] Some firms are the sole observation of their industry in their city. For these firms, since this variable equals 0, it means that there are no localization economies.

distributions of localization and urbanization variables are quite similar to the ones reported in Martin et al. (2011, p. 194, Figure 3). To avoid clutter, I display only the samples for 1998 and 2007. The solid lines represent the samples for 1998 and the dashed lines, for 2007. The distribution of localization and urbanization (size) variables for 2007 shifts to the right side of the graph as compared with those for 1998, which indicates the growth of localization and urbanization during the sample period. The diversity variables present small changes, implying that industrial diversity of firms seems to be quite steady. Regarding local competition, the distribution shifts significantly to the right side, which indicates that the local competition became more intense in 2007.

[Insert Figure 1]

2.3 Product innovation variables

This data set contains the measure of product innovation. I use three measures of innovative output, one binary variable called new product firm that indicates whether firms have introduced product innovation, and two censored variables called new product output and new product intensity (new product output/total output).[9] The criteria used by NBS for measuring the variable "new products" are as follows: New products refer to brand new products produced with new technology and new design, or products that represent noticeable improvement in terms of structure, material, or production process for significantly improving the character or function of the older versions. They include new products certified by relevant government agencies within the period of certification, as well as new products designed and produced by enterprises within a year without certification by government agencies.[10] In addition, according to Lu and Tao (2009), a product is identified as a new product by NBS only if it is produced for the first time at least within a province. As Lu and Tao (2009) point out, some of the new products may just reflect local catch-up effort in copying new products from other firms located in other regions, and to some extent, a considerable percentage of innovation in China involves imitation. However, this still represents an important step forward in product development and product innovation. Furthermore, the data set used in this study reports new product output in all ten years except in 2004, which is a

[9] Unfortunately, the data set does not contain the information about quantity, product mix, and price to calculate unit value for measuring the quality of new products.
[10] Source: *China Statistical Yearbook*, National Bureau of Statistics (NBS), 2008.

census year. To enable analysis, I interpolate new product output in 2004 by averaging the new product output of firms in 2003 and 2005.

To understand the magnitude of the flows in and out of new product introduction, I report the average annual entry and exit rates of new product introduction in Table 1. NPF stands for new product firm, while Non-NPF is non-new product firm. The first column shows that 97% of the firms that did not introduce new products in the previous year remained Non-NPFs, whereas about 3% switched from Non-NPFs to NPFs. For NPFs, about 27% stop introducing a new product, while 73% continue to produce a new product in the next year. These results suggest that there is quite a large degree of persistence in the status of new product production. Sunk costs and experience are likely to be important in the decision to introduce a new product.

[Insert Table 1]

To capture the heterogeneity between NPFs and Non-NPFs, I report the descriptive statistics of firm characteristics in Table 2.[11] These statistics suggest that there are important new product firm premiums in terms of TFP.[12] In addition to TFP, my analysis uses firm size (total employment), average wage, as well as any production subsidy received from central or local governments. NPF and Non-NPF display notable differences in terms of those characteristics. NPFs are larger than Non-NPFs in terms of employment. NPFs have higher average wage proxy for high quality workforce.[13] On average, they have production subsidies that are several times larger than those for Non-NPFs. Thus, when investigating the effects of agglomerations on innovative output in subsequent regressions, I also consider these important firm factors.

[Insert Table 2]

2.4 Production innovation by industry and by region

The innovative output is very likely to be heterogeneous across industries and

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[11] I also compare the analogous differences between NPFs and Non-NPFs by ownership (domestic firms and foreign affiliates) in the Appendix.

[12] I use Levinsohn and Petrin (2003)'s estimation method to estimate value-added based TFP for firms in each 2-digit industry and each year. The intermediate inputs are used as proxies for unobservable productivity shocks to deal with the simultaneity problem.

[13] It is possible that the quality of new products is higher than the old ones as good firms produce new products.

across regions. First, I focus on the differences of innovative output across industries. Table 3 shows the wide variations across industries regarding new product output, new product intensity (new product output/total output), and the share of new product firms. Looking at the average of all industries, new product output is 60 billion RMB, new product intensity is 3.1%, and the share of new product firms is 8.8%. However, for general machinery, transport equipment, electrical machinery, and communication equipment industry, new product output is around 104–468 billion RMB; new product intensity is high at 5.8%–9.6%; and the share of new product firms is large (around 12.5%–20.3%). On the other hand, the performance of innovative output is lower in traditional industries, such as processing of foods, manufacture of food, textile, apparel, and leather industry. New product output is around 8–44 billion RMB, new product intensity is only 1% to 2%, and the share of new product firms is small (3.9%–7.1%). These findings confirm that there are large discrepancies in the production of new products across manufacturing sectors in China. Although there is heterogeneity across industries, the figures (new product intensity and the share of new product firms) suggest that it is not very easy for firms to introduce a new product and obtain the local government certification. Therefore, the new products output reported in the data set are largely reliable.

[Insert Table 3]

Turning to the heterogeneity of innovative output across regions, I report figures of the same innovation variables in Table 4. These variables also exhibit strong variability across regions relative to the average of all regions. The coastal regions, especially, Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Shandong, and Guangdong account for a large amount of new product output. Meanwhile, inland regions, such as Inner Mongolia, Guizhou, Yunnan, Gansu, and Qinghai have very limited new product output. In terms of new product intensity, compared with all regions average (2.9%), Beijing (9.7%), Tianjin (6%), Chongqing (6.1%), and Sichuan(5.3%) are the most innovative, whereas Inner Mongolia (0.6%), Hainan (0.6%), Tibet (0.3%), and Xinjiang (1%) are the least innovative. Furthermore, Beijing, Tianjin, Chongqing, and Sichuan have the highest percentage of firms with new product introduction, exceeding 15%. On the other hand, Inner Mongolia, Hainan, Tibet, and Xinjiang have the lowest percentage of such firms at 1.3%–2.9%. These findings suggest that there are large disparities in new product production across regions in China.

[Insert Table 4]

3 Empirical analysis

In this section, I first evaluate the effects of agglomeration on the probability of new product introduction. Then I investigate how agglomeration contributes to the new product output. Finally, I conduct robustness checks.

3.1 Decision on new product introduction

The purpose of the analysis here is to identify and quantify factors (both firm-specific and industry-region specific) that increase the probability of introducing new products. I estimate these effects using a binary-choice nonstructural approach of the form

$$Y_{ft} = \begin{cases} 1: \text{New product firm} & \text{if } \alpha Y_{ft-1} + \beta X_{ft-1} + \gamma Z_{ft-1} + \mu_{ft} > 0; \\ 0: \text{Non-new product firm} & \text{otherwise} \end{cases} \tag{5}$$

where Y_{ft} is an indicator variable of whether the firm has a new product introduction. Firms show a large degree of persistence in the status of new product production as shown in Table 1; therefore, I control for the "hysteresis effect" on introducing new products. I use the lagged status of new product introduction, which is 1 if the firm did introduce a new product in the previous year and 0 if it did not.

X_{ft} is a vector of firm characteristics that affect the probability of new product introduction. As NPFs and Non-NPFs have very different characteristics as reported in Table 2, I consider several hypotheses about the role of firm-specific factors in the new product introduction. I use productivity, measured by TFP, as a measure of production technology level. It is likely that the firm with higher technology level has higher propensity to introduce a new product.[14] I use the

[14] As the research and development (R&D) data is missing for many years during the sample period, I do not use this variable although it is a more appropriate measure of innovative efforts.

number of employees as a measure of size, as larger firms may afford the R&D expenditure in developing new products and the marketing cost of new product. I also consider average wage as a proxy for labor quality of the firm. Furthermore, I use production subsidy received from government as a measure of possible incentive to firm for new product introduction. I expect these variables to have a positive effect on new product introduction.

Z_{ft} is a vector of agglomeration variables such as localization, urbanization (both size and diversity), and local competition conditions defined previously. As discussed previously, I expect the variables of urbanization economies to have positive effects on innovative output. With regard to localization economies and local competition, the effects are not very clear-cut. First, in developing countries, such as China, the lack of intellectual property rights protection may cause NPFs to slow down their investment in externality-generating activities within an industry, such as R&D. Second, it is possible that neighbors would imitate products of NPFs because imitations are still quite popular in China. However, as a new product is basically subject to the local governments' certification, the ASIF data cannot capture these new product imitations. Third, Porter (1998) argues that local competition fosters imitation and innovation. However, because there is a big technology gap between domestic firms and foreign affiliates, domestic firms with low productivity are bankrupted by their foreign competitors. For example, Hu and Jefferson (2002) find negative spillover effects of foreign direct investment on TFP of domestic firms in the electronics industry but not for the textile industry. As shown in Figure 1, local market competition has become very intense during the sample period, so on average, it is difficult to predict the effect of local competition.

μ_{ft} is the error term. In addition, to avoid problems with possible simultaneity, I lag all firm and agglomeration explanatory variables by one year.

The estimation of equation (5) raises concerns about the identification of the parameter on the lagged endogenous variables. It is quite likely that there are unobserved characteristics, such as product attributes or managerial ability that affect the decision on new product introduction by the firm. Because these characteristics are potentially permanent or highly serially correlated, and unobserved by the econometrician, they induce persistence in product innovation. In this case, usually the error term μ_{ft} can be assumed to have two components: a permanent component (firm fixed effect) ϕ_f and a transitory component ε_{ft}. As a result, I choose to use a linear probability model with firm fixed effects, which is

$$Y_{ft} = \alpha Y_{ft-1} + \beta X_{ft-1} + \gamma Z_{ft-1} + \phi_f + \varepsilon_{ft} \quad (6)$$

The main estimation results are reported in Table 5. Column 1 presents the coefficients on firm characteristics for all samples. Firm-level variables enter significantly in new product introduction and confirm the hypotheses about the role of firm specific factors. Sunk costs, as reflected by the coefficients for lagged new product firm dummy, appear to be an important factor when a firm decides to introduce a new product. The coefficient is significantly positive, suggesting that new product production in the previous year raises the probability of introducing a new product this year by about 27%. Productive firms become new product firms. The coefficient of TFP is significant, positive but the magnitude is rather small. The probability of introducing a new product increases with firm size, workforce quality, and production subsidy. Foreign ownership is another significant factor in introducing a new product even after controlling for firm fixed effects.[15]

I now turn to the effects of agglomeration. Column 2 of Table 5 reports the coefficients of agglomeration variables in addition to firm variables. The coefficient of localization is not statistically positive, implying that localization economies do not promote the introduction of new products by a firm. However, the urbanization variables, both size and diversity, are significantly positive and show that inter-industry externalities have positive effect on the introduction of new products. Local competition is not significantly positively correlated with the introduction of new products.

Furthermore, I divide all the samples into sub-samples of domestic firms and foreign affiliates. The aim is to investigate whether there are differences in factors affecting the introduction of new products by ownership. Columns 3 and 4 show the results for domestic firms and columns 5 and 6 show the results for foreign affiliates. In the case of domestic firms, all coefficients of firm characteristics are significantly positive at the 1% level. The urbanization variables are still strongly positively

[15] This result is consistent with that of Brambilla (2009). She uses firm-level data from the World Bank's 2001 Investment Climate Survey and finds that foreign affiliates introduce on average more than twice as many new varieties of products as private domestic firms.

associated with the probability of introducing new product. While in the case of foreign affiliates, the TFP and average wage are no longer significant implying that these firm characteristics are not so important to determine the introduction of new products. Regarding the agglomeration variables, the urbanization variables are still positive and significant. Conversely, the localization variables turned out to be significantly negative suggesting that localization may inhibit foreign affiliates' introduction of new products. I interpret it that the imitation by local domestic firms or lack of protection on intellectual property rights within the same industry and the same city may hurt the incentives of foreign affiliates to innovate. However, local competition may spur product innovation of foreign affiliates because they have technology advantages over domestic firms and these play an important role in the new product introduction.

[Insert Table 5]

3.2 New product output

In the second step, to investigate the effects of localization and urbanization on the new product output in China, I estimate the following equation:

$$Y_{ft} = \beta X_{ft} + \gamma Z_{ft} + \eta_i + \eta_r + \eta_t + \mu_{ft} \qquad (7)$$

where Y_{ft} is the logarithm of new product output. A number of observations equal zero, and the value of one is added to each observation before taking the logarithm. In the case of new product output estimation, the estimated coefficients on regressors can be biased downward given the substantial number of observations at zero values. Therefore, I employ the Tobit model with random effects to mitigate this problem. X_{ft} and Z_{ft} are the same vectors defined above, and η_t denotes year fixed effects. As it is not possible to control for firm fixed effects by Tobit model, I control for industry fixed effects η_i and region fixed effects η_r to address the heterogeneities across industries and regions, as discussed in Section 2.

Table 6 lists the main estimation results. Columns 1 and 2 present the results for all samples, while columns 3 and 4 for domestic firms and columns 5 and 6 for foreign affiliates. For new product output, four key findings stand out. First, the coefficients of TFP, total employment, and average wage are significant in all equations. This implies that higher firm performance leads to more new product output. Production subsidy also enters with a positive and significant coefficient suggesting that in addition to the introduction of new products, production subsidy contributes to new product output for both sets of firms. Second, the negative and statistically significant coefficient of localization suggests that innovative output tends to be lower in industries located in cities specialized in economic activity in that industry. In addition, intense local competition hurts domestic firms that have lower economic performance compared with foreign affiliates.[16] Third, urbanization economies (both scale and industrial diversity) have positive effects on new product output except as shown in column 6. For foreign affiliates, it seems that diversity, rather than urbanization size, is more conducive to new product output. Finally, and surprisingly, foreign affiliates seem to produce fewer new products compared with domestic firms, although they have a higher propensity to introduce new product.

[Insert Table 6]

3.3 Robustness check

In this sub-section, I conduct several robustness checks on my aforementioned regression results.

First, I consider the spatial selection of firms. Theoretical works (Baldwin and Okubo, 2006; Melitz and Ottaviano, 2008) show that there might be spatial selection of firms: the more productive ones are likely to self-select to locate in denser areas. In estimating equation (6), I assumed firms that do not change industry or region and used firm fixed effects to deal with the firm-level environmental unobserved characteristics. The firm fixed effects take into account all firms' specific characteristics that are invariant across time, regardless of whether those characteristics are observable. In fact, some firms in the samples do experience changes in industry and/or location. Therefore, inclusion of such observations may affect the main results reported previously. For a robustness check, for each sample, I drop all firms that changed geographical unit (city) or industrial sector during the period.[17] Consequently, the analysis does not concentrate on movers, but for a given firm, on the growth of agglomeration

[16] See the Appendix for performance variables by ownership.

[17] Indeed, I do not know if such information reflects true relocation or errors in reporting.

variables across time. Table 7 summarizes the estimation results, and it is clear that my main results (i.e., shown in Table 5) remain robust.

[Insert Table 7]

Second, I use an alternative measure of innovative output as a dependent variable. One concern regarding the estimation results of equation (7) is that larger cities might be expected to generate a large amount of innovative output, simply because of a greater degree of economic activity. For robustness check, I use new product intensity, which is another censored variable. Regression results are reported in Table 8. Clearly, the results are similar to my earlier findings.

[Insert Table 8]

Lastly, I address the industrial characteristics of product innovation. To do so, I split the samples into firms in high-tech industries and those in other industries.[18] The results for new product introduction and new product output are reported in Table 9 and Table 10, respectively. Basically, the main results remain unchanged in Table 9, that is, urbanization economies promote new product introduction in high-tech industries. In addition, there is an interesting finding. Compared with other industries, in high-tech industries, the coefficient of production subsidy is not significantly positive. This implies that production subsidy is not likely to be a useful tool to promote new product introduction in high-tech industries. Meanwhile, the size and diversity of neighboring industries stimulate new product entries. This is especially significant for domestic firms. Regarding the new product output, there are some differences between high-tech industries and other industries. The negative coefficient of localization economies indicates that greater specialization within a city impedes new product output of high-tech industries, whereas the positive coefficients of urbanization (both size and diversity) support Jacobs' theory that the scale and diversity of economic activity are more conducive to new product output of high-tech industries. In other industries, firms are likely to benefit from

[18] Here, I drop firms that changed the industry and/or location. The high-tech industries include Manufacture of medicines, Manufacture of aircrafts and spacecrafts (sub-industry in Transport equipment industry), Communication equipment, Manufacture of medical equipment (sub-industry in Special machinery), and measuring instrument. The list of high-tech industries is defined by the Ministry of Science and Technology and National Bureau of Statistics (NBS).

diversity only. This implies that urban diversity is more important to new product output than urban size.

[Insert Table 9]

[Insert Table 10]

4 Conclusion

Previous studies found that agglomeration is conducive to performance of Chinese manufacturing firms in terms of TFP and export entry. In this study, I investigated the effect of agglomeration of economic activities on product innovation that directly reflects the industry upgradation and economic growth of China. I followed Martin et al. (2011) to decompose carefully the agglomeration effects into localization economies (intra-industry externalities) and urbanization economies (inter-industry externalities), as well as diversity and competition effects. I ran the estimations carefully after addressing firm-specific characteristics (such as productivity, firm size, labor quality, and production subsidy) and controlling for firm fixed effects or random effects, industry fixed effects, and region fixed effects. The results show that urbanization economies (scale and diversity) have positive effects, unlike localization economies, on the innovative output of Chinese firms. Specifically, urbanization economies contribute to both new product introduction and new product output. The results remain robust to using sub-samples, alternative variables, and panel estimation methods.

These findings have important implications for both firms and policymakers:

For firms located in diversified cities, their innovative activities benefit from urban size and diversity. If firms choose to locate in narrow localized or specialized areas, they are likely to have low propensity to innovate in terms of new product introduction. Moreover, specialization lacking inter-industrial linkage and local competition strength is likely to have negative effects on new product output.

For policymakers, this implies that urbanization or diversity can be an important and effective channel to foster product innovation. First, the policymakers could promote product innovation by encouraging firms to locate in industrial diversified areas. Chinese authorities have been actively promoting quality upgrades to China's product structure through tax, subsidy, and other policy incentives. Since 1995, central and local governments have supported the establishment of more than 100 economic zones (such as economic and technological development areas and high-technology industry development areas) in more than 60 cities. Note that most of these economic zones such as Shenzhen Economic Zone (Guangdong Province), Suzhou Industrial Park (Jiangsu Province) are not clusters of firms from the same narrow defined industry such as a 2-digit or 3-digit industry. Therefore, the results of this study provide support for such a policy. However, it is important to note the significance of neighboring industries' diversity rather than spatial concentration of own-industry. Second, the Chinese government should continue to promote the process of urbanization. Fujita et al. (2004) and Au and Henderson (2006) suggest that the majority of Chinese cities are undersized with strong spatial biases to policies such as those related to migration, capital allocation, and infrastructure allocation. In practice, migration restrictions that might hinder agglomeration and innovation should be gradually abolished.

This study suggests that the growth of urban size and diversified environment are likely to lower the sunk costs for firms' new product introduction. In turn, this may reduce the burden of the production subsidy provided by central and local governments. The results reported in Table 9 indicate that urbanization economies are an even more effective factor to promote new product introduction than production subsidies in high-tech industries. This important issue deserves further research.

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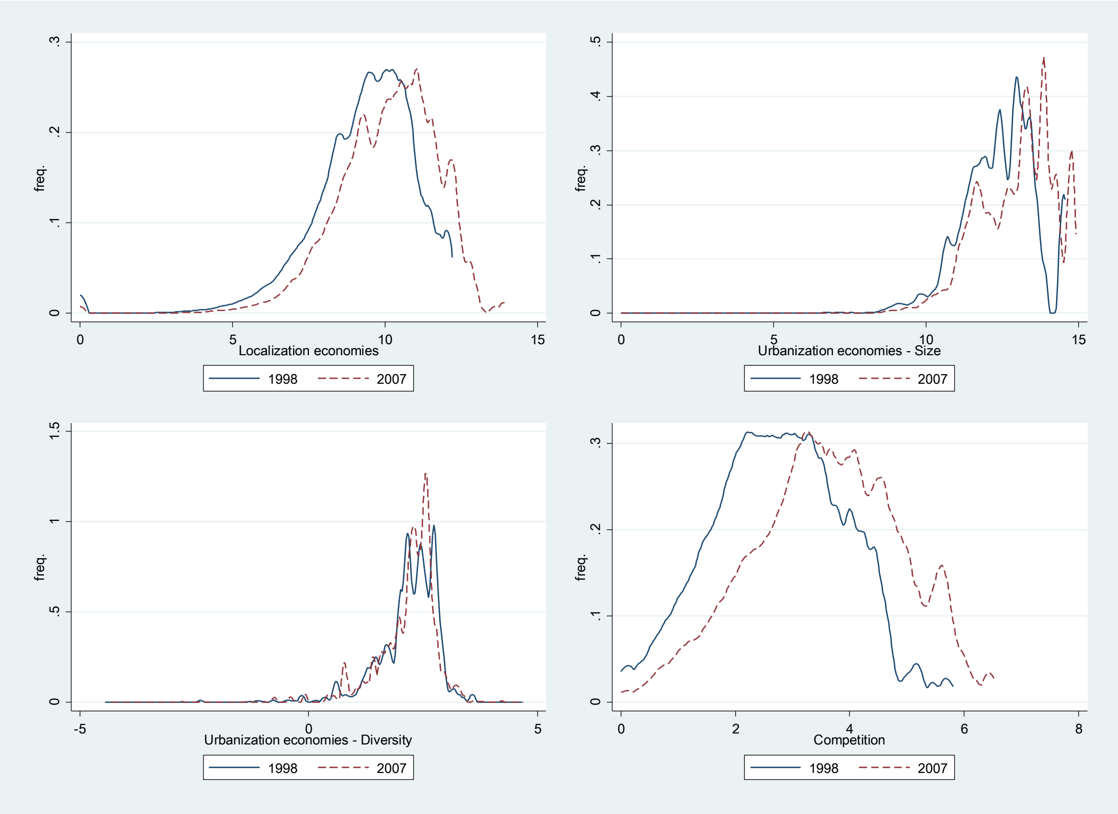
Figure 1. Distribution of agglomeration variables in 1998 and 2007



Note: The variables are constructed at 2-digit industry-city level.

Table 1. Transitions in and out of new product introduction

	Current status	
Last year status	Non-NPF	NPF
Non-NPF	97.01	2.99
NPF	26.81	73.19

Note: NPF stands for new product firm, while Non-NPF is non-new product firm.

Table 2. Firm characteristics of new product firm (NPF) and non-new product firm (Non-NPF)

Year	TFP		Employment		Average wage		Production subsidy		Number of firms	
	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF
1998	5.27	4.74	1,119	275	11	10	576	82	10,171	112,994
1999	5.33	4.79	1,083	277	10	9	642	92	10,477	121,606
2000	5.47	4.90	1,020	268	12	10	839	106	10,569	123,824
2001	5.57	4.99	880	246	13	11	582	128	10,898	133,074
2002	5.68	5.10	872	240	14	11	716	137	11,285	143,564
2003	5.82	5.24	844	235	15	12	859	146	11,560	160,608
2004	5.66	5.22	487	194	15	13	485	131	25,414	219,088
2005	5.83	5.38	518	208	17	14	682	174	24,224	218,053
2006	5.92	5.50	490	200	18	16	683	159	28,276	242,098
2007	6.00	5.63	524	191	22	18	716	141	27,657	276,845

Note: The average wage and production subsidy are in thousand RMB.

Table 3. Product innovation by industry

Industry	New product output (billion RMB)	New product output/Output (%)	Share of new product firm (%)	Number of firms
All industries	60	3.1	8.8	6,865
Processing of foods	12	1.0	4.4	11,772
Manufacture of food	10	2.1	7.1	4,685
Beverages	15	2.3	9.0	3,260
Textiles	44	2.0	6.3	16,664
Apparel	14	1.8	3.9	9,396
Leather	8	2.0	4.8	4,652
Timber	4	1.8	4.4	4,194
Furniture	3	1.8	5.8	2,249
Paper	10	1.2	4.2	5,778
Printing	4	1.3	3.5	4,011
Articles for cultures and sports	4	2.5	6.4	2,560
Petroleum	14	1.7	5.8	1,661
Raw chemicals	56	3.0	9.1	13,984
Medicines	47	7.5	21.7	4,028
Chemical fibers	15	3.6	10.3	970
Rubber	17	2.9	9.3	2,299
Plastics	16	2.2	5.9	8,982
Non-metallic minerals	25	1.9	6.1	16,652
Smelting of ferrous metals	91	1.5	5.5	4,607
Smelting of non-ferrous metals	20	2.2	6.9	3,362
Metal	18	2.0	5.9	10,432
General machinery	104	3.8	12.5	14,644
Special machinery	66	5.8	15.8	8,032
Transport equipment	388	4.9	13.6	9,161
Electrical machinery	170	4.9	13.0	11,429
Communication equipment	468	9.6	18.6	6,281
Measuring instruments	24	8.3	20.3	2,689
Manufacture of artwork	5	2.0	5.5	3,798

Note: All figures are the average during the sample period (1998-2007).

Table 4. Product innovation by region

Region	New product output (billion RMB)	New product output/Output	Share of new product firm (%)	Number of firms
All regions	54	2.9	8.5	6,214
Beijing	115	9.7	15.7	4,412
Tianjin	126	6.0	15.5	4,088
Hebei	25	1.4	4.7	7,114
Shanxi	10	1.8	6.1	2,270
Inner Mongolia	3	0.6	2.3	1,389
Liaoning	73	3.3	9.0	7,400
Jilin	71	4.5	12.5	2,178
Heilongjiang	16	1.7	5.2	2,168
Shanghai	169	2.6	6.4	11,069
Jiangsu	181	2.7	6.8	26,051
Zhejiang	172	4.0	10.2	27,503
Anhui	36	3.6	10.1	4,202
Fujian	32	1.2	3.5	8,070
Jiangxi	12	2.4	7.3	3,093
Shandong	150	2.2	6.9	17,983
Henan	34	2.1	20.5	8,536
Hubei	44	3.4	9.7	5,839
Hunan	27	3.0	8.6	5,142
Guangdong	210	2.2	5.6	25,288
Guangxi	22	3.5	9.8	2,616
Hainan	0	0.6	1.4	388
Chongqing	47	6.1	17.0	2,065
Sichuan	63	5.3	16.9	5,063
Guizhou	5	2.0	7.0	1,464
Yunnan	5	1.7	6.5	1,586
Tibet	0	0.3	1.3	116
Shaanxi	20	3.2	10.1	2,074
Gansu	5	2.5	8.4	1,771
Qinghai	1	2.4	8.2	264
Ningxia	2	2.6	8.4	423
Xinjiang	2	1.0	2.9	1,002

Note: All figures are the average during the sample period (1998-2007).

Table 5. Main results: The decision on new product introduction

New product firm dummy	(1)	(2)	(3)	(4)	(5)	(6)
	Full samples		Domestic firms		Foreign affiliates	
New product firm last year	0.269***	0.268***	0.269***	0.269***	0.240***	0.240***
	[0.002]	[0.002]	[0.003]	[0.003]	[0.006]	[0.006]
TFP	0.001***	0.001***	0.001***	0.001***	0.001	0.001
	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]
Total employment	0.015***	0.014***	0.017***	0.015***	0.009***	0.008***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Average wage	0.003***	0.003***	0.003***	0.003***	0.002	0.002
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Production subsidy	0.002***	0.002***	0.001***	0.001***	0.002***	0.002***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Foreign affiliate	0.008***	0.007***				
	[0.003]	[0.003]				
Localization economies		-0.001		0.000		-0.003**
		[0.001]		[0.001]		[0.001]
Urbanization economies - size		0.024***		0.033***		0.008**
		[0.002]		[0.002]		[0.003]
Urbanization economies - diversity		0.011***		0.012***		0.009***
		[0.001]		[0.002]		[0.003]
Competition		0.001		-0.001		0.006***
		[0.001]		[0.001]		[0.001]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	1,388,718	1,388,718	1,086,209	1,086,209	302,509	302,509
r2	0.685	0.685	0.691	0.691	0.683	0.683

Note: All firm characteristics are lagged one year. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. All standard errors are heteroskedastic-consistent.

Table 6. Main results: The new product output

New product output	(1)	(2)	(3)	(4)	(5)	(6)
	Full samples		Domestic firms		Foreign affiliates	
TFP	0.596***	0.590***	0.623***	0.621***	0.556***	0.527***
	[0.020]	[0.020]	[0.022]	[0.022]	[0.048]	[0.048]
Total employment	3.086***	3.089***	3.426***	3.411***	1.998***	2.084***
	[0.025]	[0.025]	[0.028]	[0.028]	[0.062]	[0.062]
Average wage	1.365***	1.402***	1.446***	1.469***	1.185***	1.268***
	[0.036]	[0.037]	[0.040]	[0.041]	[0.084]	[0.085]
Production subsidy	0.238***	0.238***	0.209***	0.210***	0.356***	0.351***
	[0.008]	[0.008]	[0.008]	[0.008]	[0.020]	[0.020]
Foreign affiliate	-1.392***	-1.309***				
	[0.070]	[0.071]				
Localization economies		-0.205***		-0.074***		-0.507***
		[0.025]		[0.027]		[0.072]
Urbanization economies - size		0.081**		0.176***		-0.490***
		[0.036]		[0.039]		[0.097]
Urbanization economies - diversity		0.541***		0.373***		1.065***
		[0.045]		[0.048]		[0.120]
Competition		-0.199***		-0.327***		0.426***
		[0.032]		[0.034]		[0.082]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	1,922,285	1,922,285	1,520,912	1,520,912	401,373	400,062
P-value of Likelihood-ratio test for sigma_u = 0	0.000	0.000	0.000	0.000	0.000	0.000

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The figures in brackets are the standard errors.

Table 7. Spatial selection of firms

New product firm dummy	(1)	(2)	(3)	(4)	(5)	(6)
	Full samples		Domestic firms		Foreign affiliates	
New product firm last year	0.262***	0.262***	0.262***	0.262***	0.234***	0.234***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.007]	[0.007]
TFP	0.001***	0.001***	0.001***	0.001***	0.000	0.000
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]
Total employment	0.015***	0.014***	0.016***	0.015***	0.010***	0.009***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
Average wage	0.003***	0.003***	0.003***	0.003***	0.002	0.002
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
Production subsidy	0.001***	0.001***	0.001***	0.001***	0.002***	0.002***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Foreign affiliate	0.008***	0.008**				
	[0.003]	[0.003]				
Localization economies		0.001		0.001		0.001
		[0.001]		[0.001]		[0.002]
Urbanization economies - size		0.024***		0.031***		0.009**
		[0.002]		[0.003]		[0.004]
Urbanization economies - diversity		0.014***		0.015***		0.011**
		[0.002]		[0.002]		[0.005]
Competition		0.001		-0.001		0.005***
		[0.001]		[0.001]		[0.002]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	1,145,414	1,145,414	907,556	907,556	237,858	237,858
r2	0.693	0.693	0.698	0.698	0.693	0.693

Note: All firm characteristics are lagged one year. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. All standard errors are heteroskedastic-consistent.

Table 8. Alternative measure of new product output

New product intensity (%)	(1)	(2)	(3)	(4)	(5)	(6)
	Full samples		Domestic firms		Foreign affiliates	
TFP	1.459***	1.437***	1.483***	1.474***	1.636***	1.484***
	[0.101]	[0.101]	[0.108]	[0.108]	[0.267]	[0.268]
Total employment	12.930***	12.968***	14.125***	14.084***	8.914***	9.334***
	[0.127]	[0.127]	[0.135]	[0.136]	[0.341]	[0.343]
Average wage	6.475***	6.591***	6.743***	6.769***	5.859***	6.284***
	[0.186]	[0.188]	[0.201]	[0.203]	[0.468]	[0.474]
Production subsidy	1.146***	1.147***	0.998***	0.997***	1.869***	1.835***
	[0.040]	[0.040]	[0.042]	[0.042]	[0.113]	[0.113]
Foreign affiliate	-5.514***	-5.258***				
	[0.355]	[0.359]				
Localization economies		-0.962***		-0.336**		-2.404***
		[0.129]		[0.134]		[0.399]
Urbanization economies - size		0.542***		0.992***		-2.708***
		[0.183]		[0.191]		[0.532]
Urbanization economies - diversity		2.457***		1.609***		5.258***
		[0.227]		[0.235]		[0.663]
Competition		-0.662***		-1.185***		2.158***
		[0.161]		[0.169]		[0.452]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	1,922,285	1,922,285	1,520,912	1,520,912	401,373	400,062
P-value of Likelihood-ratio test for sigma_u = 0	0.000	0.000	0.000	0.000	0.000	0.000

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The figures in brackets are the standard errors.

Table 9. High-tech industries and other industries: new product introduction

New product firm dummy	(1)	(2)	(3)	(4)	(5)	(6)
	High-tech			Others		
	Full	Domestic	Foreign	Full	Domestic	Foreign
New product firm last year	0.274***	0.273***	0.254***	0.260***	0.261***	0.229***
	[0.009]	[0.011]	[0.015]	[0.003]	[0.003]	[0.007]
TFP	0.002	0.005*	-0.002	0.001**	0.001**	0.001
	[0.002]	[0.003]	[0.003]	[0.000]	[0.001]	[0.001]
Total employment	0.021***	0.026***	0.011**	0.013***	0.014***	0.009***
	[0.004]	[0.006]	[0.006]	[0.001]	[0.001]	[0.002]
Average wage	0.006*	0.012**	-0.002	0.003***	0.003***	0.003*
	[0.004]	[0.005]	[0.005]	[0.001]	[0.001]	[0.002]
Production subsidy	0.001	0.002	0.000	0.001***	0.001***	0.002***
	[0.001]	[0.001]	[0.002]	[0.000]	[0.000]	[0.000]
Foreign affiliate	-0.004			0.009***		
	[0.012]			[0.003]		
Localization economies	-0.004	-0.007	0.010	0.001	0.002*	-0.001
	[0.004]	[0.005]	[0.008]	[0.001]	[0.001]	[0.002]
Urbanization economies - size	0.038***	0.066***	-0.006	0.022***	0.028***	0.012***
	[0.010]	[0.014]	[0.016]	[0.002]	[0.003]	[0.004]
Urbanization economies - diversity	0.018*	0.025**	0.008	0.013***	0.014***	0.012**
	[0.010]	[0.012]	[0.018]	[0.002]	[0.002]	[0.005]
Competition	-0.004	-0.004	-0.009	0.001	-0.001	0.007***
	[0.005]	[0.007]	[0.008]	[0.001]	[0.001]	[0.002]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	78,381	49,905	28,476	1,067,033	857,651	209,382
r2	0.746	0.756	0.725	0.680	0.684	0.681

Note: All firm characteristics are lagged one year. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. All standard errors are heteroskedastic-consistent.

Table 10. High-tech industries and other industries: new product output

New product output	(1)	(2)	(3)	(4)	(5)	(6)
	High-tech			Others		
	Full	Domestic	Foreign	Full	Domestic	Foreign
TFP	0.828***	0.797***	1.065***	0.548***	0.601***	0.327***
	[0.048]	[0.053]	[0.107]	[0.024]	[0.026]	[0.062]
Total employment	2.236***	2.856***	1.391***	3.265***	3.493***	2.460***
	[0.065]	[0.075]	[0.140]	[0.030]	[0.033]	[0.080]
Average wage	1.790***	1.912***	1.890***	1.347***	1.408***	1.144***
	[0.092]	[0.104]	[0.191]	[0.044]	[0.049]	[0.110]
Production subsidy	0.212***	0.179***	0.260***	0.223***	0.200***	0.352***
	[0.018]	[0.019]	[0.042]	[0.010]	[0.010]	[0.026]
Foreign affiliate	-3.142***			-0.899***		
	[0.178]			[0.086]		
Localization economies	-0.431***	-0.154**	-1.221***	-0.045	0.011	-0.069
	[0.068]	[0.071]	[0.177]	[0.033]	[0.035]	[0.100]
Urbanization economies - size	0.736***	0.509***	1.203***	-0.123***	0.043	-0.983***
	[0.119]	[0.125]	[0.289]	[0.043]	[0.047]	[0.121]
Urbanization economies - diversity	0.655***	0.483***	1.252***	0.542***	0.369***	1.057***
	[0.140]	[0.143]	[0.372]	[0.054]	[0.058]	[0.152]
Competition	-0.373***	-0.803***	-0.085	-0.246***	-0.413***	0.577***
	[0.099]	[0.220]	[0.109]	[0.039]	[0.041]	[0.105]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	110,436	71,140	39,296	1,514,533	1,230,014	284,519
P-value of Likelihood-ratio test for sigma_u = 0	0.000	0.000	0.000	0.000	0.000	0.000

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The figures in brackets are the standard errors.

Appendix:

A1. Samples

Year	Original data	Remaining observations	
	Total	All firms	(%)
1998	148,685	123,165	83
1999	146,101	132,083	90
2000	147,253	134,393	91
2001	154,324	143,972	93
2002	165,861	154,849	93
2003	181,079	172,168	95
2004	258,945	244,502	94
2005	251,061	242,277	97
2006	278,753	270,374	97
2007	313,048	304,502	97

Source: Annual Surveys of Industrial Firms (ASIF), China's National Bureau of Statistics (NBS)

A2. Summary statistics

Variables	Mean	Std. Dev.	Min	Max	Obs
New product firm dummy	0.089	0.284	0	1	1,922,285
New product output	0.795	2.628	0	18.579	1,922,285
TFP	5.277	1.165	-6.342	11.650	1,922,285
Total employment	4.777	1.115	2.197	12.145	1,922,285
Average wage	2.382	0.625	0	11.225	1,922,285
Production subsidy	0.659	1.887	0	14.207	1,922,285
Localization economies	9.761	1.735	0	13.986	1,922,285
Urbanization economies - size	12.699	1.238	0	14.913	1,922,285
Urbanization economies - diversi	2.182	0.673	-8.317	8.317	1,922,285
Competition	3.233	1.314	0	6.519	1,922,285
Foreign firm dummy	0.209	0.406	0	1	1,922,285

A3. Firm characteristics of new product firm (NPF) and non-new product firm (Non-NPF), Domestic firms

	TFP		Employment		Average wage		Production subsidy		Number of firms	
Year	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF
1998	5.22	4.66	1,215	279	10	8	608	84	8,671	92,735
1999	5.29	4.71	1,181	275	9	8	700	102	8,785	98,553
2000	5.42	4.82	1,113	262	11	9	942	119	8,796	99,255
2001	5.55	4.92	965	236	12	10	671	148	8,711	105,843
2002	5.64	5.04	935	225	13	10	829	152	9,375	113,726
2003	5.77	5.18	900	213	14	11	978	164	9,387	126,074
2004	5.61	5.17	483	166	13	12	505	135	20,585	170,057
2005	5.81	5.33	516	174	15	13	718	182	19,623	168,715
2006	5.89	5.44	471	163	17	14	670	166	22,837	189,312
2007	5.95	5.59	511	154	20	16	719	143	21,207	218,665

Note: The average wage and production subsidy are in thousand RMB.

Firm characteristics of new product firm (NPF) and non-new product firm (Non-NPF), Foreign affiliates

	TFP		Employment		Average wage		Production subsidy		Number of firms	
Year	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF	NPF	Non-NPF
1998	5.54	5.10	565	254	17	17	393	77	1,500	20,259
1999	5.57	5.13	574	283	16	13	340	49	1,692	23,053
2000	5.73	5.21	561	291	18	14	329	54	1,773	24,569
2001	5.66	5.26	541	287	19	15	231	49	2,187	27,231
2002	5.88	5.35	565	298	21	16	157	81	1,910	29,838
2003	6.01	5.43	603	316	22	16	343	80	2,173	34,534
2004	5.86	5.38	507	293	22	17	400	114	4,829	49,031
2005	5.95	5.55	527	325	24	19	530	146	4,601	49,338
2006	6.04	5.69	568	334	25	21	741	137	5,439	52,786
2007	6.16	5.77	567	332	29	24	706	130	6,450	58,180

Note: The average wage and production subsidy are in thousand RMB.