

The Study of the Effect of Patent Application on SME Financing (*)

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The situations of regional financial concentration and competition are different between small and large cities in Japan. In this research, we analyze the effect of regional financial concentration and competition on the growth and survival of small and medium-sized enterprises (SMEs) by using Japanese official data, to indirectly clarify the regional financial concentration and competition in SME financing. The results show that regional financial concentration increases the exit rate of SMEs, and that the regional financial competition promotes the growth of SMEs and reduces the exit rate of SMEs.

Additionally, recently, policies to promote SMEs finance utilizing intellectual property have been established in Japan. We analyze how the regional financial concentration and competition affect the effect of patent application on SME growth and survival by using Japanese official data connected to patent data, to indirectly clarify the effect of patent application on the relationship between regional finance situation and SME financing. The results show that the regional financial concentration reduces the risk of exit by patent application, and the regional financial competition increases the effect of promoting firm growth by patent application and decreases the risk of exit by patent application.

I. Introduction

In Japan, small and medium-sized enterprises (SMEs) play a major role to support economic activity and employment in Japan¹. But many SMEs are have constrained finances. Especially, newer SMEs face more financial constraint. In SME financing, financial institutions like banks play an important role, because the financial dependence of SMEs on banks is higher than for large firms.

Recently, financial institutions are becoming more important in regional policy in Japan, because it is gradually becoming clear that innovation projects to promote regional development have constrained finances. And financial institutions are expected to play a role of business management support besides financial support. Since the late 2010s, regional policies attempt to make industry-academia-government networks with financial institutions more strongly included.

The situations of regional financial concentration and competition are different between small

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¹ According to q Japan Small and Medium Enterprise Agency report, the number of SMEs accounts for about 99% of all firms and the number of employees in SMEs accounts for about 70% of all employees in Japan.

and large cities in Japan². In the previous study, it is a concern that venture capital (VC) concentration causes a regional equity gap because VCs prefer to invest in neighboring start-ups (Martin et al. 2005). Furthermore, the empirical evidence on whether bank competition promotes finance constraint reduce and firm growth is inconclusive (de Guevara & Maudos 2009). If regional financial concentration and competition affect SMEs' financial constraints, it is a concern that a regional gap of SMEs financing is caused. Furthermore, it is a concern that a gap in regional development through SMEs activities is caused.

Additionally, in recent years, policies to promote SMEs finance utilizing intellectual property have been established in Japan. Innovative firms face severe difficulties in external financing, because innovation is a risky activity characterized by high levels of uncertainty and outputs of innovation are difficult to measure, evaluate and manage (Munari et al. 2011). But patents are expected to help SME financing because they can act as a tangible signal of a firm's ability and reduce uncertainty by protecting their technologies (Levitas & McFadyen 2009; Kulatilaka & Lin 2006). If patents help to reduce SMEs' financial constraints, it is considered that patents affect the relationships between regional financial concentration and the growth and survival of SMEs.

In this context, the purposes of this study are the following two. One is to provide empirical evidence of the effect of regional financial concentration and competition on SMEs' growth and survival to indirectly clarify how the regional financial concentration and competition affects SME financing. The other is to provide empirical evidence of the relationships between regional financial concentration, competition and the effect of patents on SME growth and survival to indirectly clarify the effect of patent application on the relationship between regional finance situation and SME financing.

The paper is structured as follows. Section II describes the situations of regional financial concentration and competition in Japan. Section III discusses the hypothesis and related theory. The sources of the data and the adopted modeling analysis are discussed in section IV. Section V describes the results of the analysis and considerations. Finally, Section VI concludes with a summary of the findings and directions for future work.

² Refer to Section II.

II. Regional financial concentration and competition in Japan

In this section, in order to ascertain the trends of Japanese financial industry concentration and competition, we compare the trends of financial industry with the trends of other industries and compare the regional financial industry trends by city size.

1. Trends compared with other industries

First, we use Lorenz curves and local Gini coefficients to clarify whether the financial industry is more agglomerate than other industries. The Lorenz curve of financial employees is more strongly curved than that of other industries. And the local Gini coefficient of financial employees is higher than that of other industries' employees. From these results, we find that more agglomeration in the financial industry than in other industries.

Next, we use the entry and exit rates and the establishment period as indexes to clarify whether the financial industry is more competitive than other industries. The entry and exit rates of financial industry offices are lower than those of other industries. And financial industry offices are established earlier than those of other industries. From these results, we ascertain that financial industry offices are replaced less frequently than in other industries and survive longer; in other words, the competitive environment of financial institutions is more stable than that of other industries.

2. Trends by city size

First, we use the number of employees by financial office and the specialization coefficient of financial employees as indexes to clarify whether the larger a city's financial industry, the more agglomeration. The larger the city, the more employees in financial offices and the higher the specialization coefficient of the financial employees. This means the larger the city, the larger and more agglomerated the financial offices.

Next, we use four indexes to clarify whether the larger a city's financial industry, the more competitive. The first indexes are the entry and exit rates, the second is the establishment period, the third is the share of banks that are profit-making corporations, and the last is the Herfindahl-Hirschman index (HHI) which is famous as a statistical measure of concentration. The larger city, the higher the entry and exit rates of financial offices and the shorter the establishment period thereof. And the larger city, the higher the share of banks and the lower the HHI of the financial office. That is, the larger the city, the more competitive the environment of financial institutions.

III. Theory and Hypothesis

In this part, we develop testable hypotheses about the relationships between regional financial concentration and the growth and survival of SMEs and the effect of patents on SME growth and survival by discussing two viewpoints: geographical proximity and relationship banking. For the case of regional financial competition, we discuss two viewpoints: the principle of competition and relationship banking.

1. The relationships between regional financial concentration and the growth and survival of SMEs

First, geographical proximity helps to decrease the information asymmetry and promote gaining of credit by making direct contact easier (Lutz et al. 2013). Therefore, if there are many financial offices nearby, SMEs are more likely to make contacts with financial institutions, which makes it easier to raise funds.

Hypothesis 1-1A: SMEs in the region where financial offices are more concentrated grow rapidly.

Hypothesis 1-2A: SMEs in the region where financial offices are more concentrated survive more.

Second, the financial concentration decreases relational switching costs of SMEs because it makes it easier to search for a partner. Then, financial offices have less incentive to conduct relationship banking due to the risk of failure in recovering information costs. Therefore, if there are many financial offices nearby, it makes it difficult for SMEs to finance by relationship banking.

Hypothesis 1-1B: SMEs in the region where financial offices are less concentrated grow rapidly.

Hypothesis 1-2B: SMEs in the region where financial offices are less concentrated survive more.

2. The relationships between regional financial concentration and the effect of patents on SMEs growth and survival

Patents can act as a useful signal of decreasing information asymmetry by showing firms' innovation and technological capacity to external investors (Levitas & McFadyen 2009). Furthermore, patents are tools which firms can use to protect their technologies and acquire fees from the licensing of technologies to third parties (Kulatilaka & Lin 2006). Hence, patents help to reduce financing constraints, and as a result, firms' growth and survival are promoted. When it is difficult to make the mechanisms which help SME growth and survival work, we expected this effect of patents on SMEs growth and survival to increase.

Namely, the effect of patents is increased in regions where financial offices are less concentrated because SMEs are less likely to make contacts with financial institutions.

Hypothesis 2-1A: SMEs which are patent applicants in a region where financial offices are less concentrated grow rapidly.

Hypothesis 2-2A: SMEs which are patent applicants in a region where financial offices are less concentrated survive more.

Whereas, the effect of patents is increased in regions where financial offices are more concentrated because it makes it difficult for SMEs to finance by relationship banking.

Hypothesis 2-1B: SMEs which are patent applicants in a region where financial offices are more concentrated grow rapidly.

Hypothesis 2-2B: SMEs which are patent applicants in a region where financial offices are more concentrated survive more.

3. The relationships between regional financial competition and the growth and survival of SMEs

First, the financing cost of SMEs is lower in regions where financial offices keenly compete because the principle of competition works strongly, and SMEs actively deal with financial institutions (Angelini et al. 1998; Berlin & Mester 1999). In addition, the hold-up problem (Rajan 1992) is less likely to come up because SMEs can avoid being locked-in to a particular financial institution.

Hypothesis 3-1A: SMEs in the region where financial offices keenly compete grow rapidly.

Hypothesis 3-2A: SMEs in the region where financial offices keenly compete survive more.

From another point of view, it makes it difficult for SMEs to finance by relationship banking because relational switching costs of SMEs are lower in regions where financial offices keenly compete.

Hypothesis 3-1B: SMEs in the region where financial offices dully compete grow rapidly.

Hypothesis 3-2B: SMEs in the region where financial offices dully compete survive more.

4. The relationships between regional financial competition and the effect of patents on SMEs growth and survival

As in the case of concentration, when it is difficult to make the mechanisms which help SME growth and survival as described in the previous section work, we expected this effect of patents on SMEs growth and survival to increase.

Namely, the effect of patents is increased in regions where financial offices dully compete because the principle of competition works weakly.

Hypothesis 4-1A: SMEs which are patent applicants in the region where financial offices dully compete grow rapidly.

Hypothesis 4-2A: SMEs which are patent applicants in the region where financial offices dully compete survive more.

Whereas, the effect of patents is increased in regions where financial offices keenly compete because it makes it difficult for SMEs to finance by relationship banking.

Hypothesis 4-1B: SMEs which are patent applicants in regions where financial offices keenly compete grow rapidly.

Hypothesis 4-2B: SMEs which are patent applicants in regions where financial offices keenly compete survive more.

IV. Methods

We adopt the following two models for analyzing the effect of regional financial concentration and competition on SMEs' growth and survival, which are based on the analysis model adopted in previous studies³.

(1) Growth-rate Analysis Model

$$\begin{aligned} [\text{Growth}]_{ijk} = & \alpha[\text{Bank Dependence}]_j * [\text{Bank Concentration}]_k \\ & + \beta[\text{Bank Dependence}]_j * [\text{Bank Competition}]_k + \gamma[\text{Patent}]_j \\ & + \delta_1[\text{Firm Year}]_i + \delta_2[\text{Firm Size}]_i + \delta_3[\text{Area Size}]_k + \delta_4[\text{Industry Growth}]_j \\ & + \delta_5[\text{Area Effect}]_{k'} + \delta_6[\text{Industry Effect}]_{j'} + \varepsilon_{ijk} \end{aligned}$$

³ As representative studies, Rajan & Zingales (1998), CETORELLI & STRAHAN (2006) and de Guevara & Maudos (2009) are cited.

(2) Exit-rate Analysis Model

$$\begin{aligned} [\text{Dead Rate}]_{ijk} = & \alpha[\text{Bank Dependence}]_j * [\text{Bank Concentration}]_k \\ & + \beta[\text{Bank Dependence}]_j * [\text{Bank Competition}]_k + \gamma[\text{Patent}]_j \\ & + \delta_1[\text{Firm Year}]_i + \delta_2[\text{Firm Size}]_i + \delta_3[\text{Area Size}]_k + \delta_4[\text{Industry Growth}]_j \\ & + \delta_5[\text{Area Effect}]_{k'} + \delta_6[\text{Industry Effect}]_{j'} + \varepsilon_{ijk} \end{aligned}$$

where i is the firm; j is the industry middle sector; j' is the industry large sector; k is the city in which the firm is located; and k' is the prefecture in which the firm is located. Regarding the dependent variables, [Growth] is the firm's employees growth rate and [Dead Rate] is the firm's exit dummy variable. Regarding the independent variables, [Bank Concentration]⁴ is the indicator of the degree of bank agglomeration in city k , which is proxied by the specialization coefficient of the financial employees; [Bank Competition]⁴ is the indicator of the degree of bank concentration in city k , which is proxied by the Herfindahl-Hirschman index (HHI) of bank offices; and [Patent] is the indicator of the firm's activity in patent application, which is proxied by the amount of the firm's patent applications or a patent application dummy variable. Regarding the control variables, [Firm Year] is the period from the firm's establishment year until 2009; [Firm Size] is the number of the firm's employees; [Area Size] is the number of offices in city k ; and [Industry Growth] is the industry's employee growth rate. Finally, [Area Effect] and [Industry Effect], which are proxied by prefecture and sector dummy variables, capture the influence of effects specific to each prefecture or sector, respectively.

Firstly, we adopt OLS analysis in the growth-rate analysis model and probit analysis in the exit-rate analysis model in order to clarify the effect of regional financial concentration and competition on SME growth and survival. Secondly, we divide cities into two groups depending on the degree of regional financial concentration or competition and compare the effect of patents on SME growth and survival of two groups in order to clarify the relationships between regional financial concentration and the effect of patents on SME growth and survival.

In this analysis, we use the data that we constructed based on patent data and office census data. The patent data consists of applicants and patent information in Japan between 1989 and 2008. The office census data consists of data on SMEs which have a single office in 2009 and 2012.

⁴ We adopt [Bank Dependence], which is the indicator of the degree of bank financial dependence of SMEs or all firms in sector j , in order to consider the effect of external financial dependence.

V. Results and Consideration

1. The relationships between regional financial concentration and the growth and survival of SMEs

Regarding the relationships between regional financial concentration and the growth of SMEs, we find no significant effect. Whereas, we confirm that the coefficient of the relationships between regional financial concentration and the exit-rate of SMEs has a significantly positive. From these results, hypothesis 1-2B is supported. That is, these results suggest that regional financial concentration does not affect SMEs' growth but increases the risk of exit for SMEs. We are concerned that SMEs suffer relationship banking constraints in regions where financial offices are more concentrated.

2. The relationships between regional financial concentration and the effect of patents on SMEs growth and survival

First, regarding the effect of patents on SME growth and survival, the results show that patents have a positive effect in promoting SME growth and a negative effect in promoting SMEs survival.

Next, regarding the relationships between regional financial concentration and these patent effects, we confirm that regional financial concentration does not affect the patent positive effect on SME growth but reduces the patent negative effect on SME survival. From these results, hypothesis 2-2B is supported. We suggest that patents help to reduce financing constraints more effectively in regions where financial offices are more concentrated.

3. The relationships between regional financial competition and the growth and survival of SMEs

Regarding the relationships between regional financial competition and the growth of SMEs, we find a significant negative effect. Regarding the relationship to SME survival, we confirm a significant positive effect. From these results, hypothesis 3-1B and hypothesis 3-2B are supported. That is, these results suggest that regional financial competition slows down SMEs' growth and increases the risk of exit for SMEs. We are concerned that SMEs suffer relationship banking constraints in regions where financial offices keenly compete.

4. The relationships between regional financial competition and the effect of patents on SMEs growth and survival

Regarding the relationships between regional financial competition and these patent effects, we confirm that regional financial competition decreases the patent positive effect on SME growth and increases the patent negative effect on SME survival. From these results, hypothesis 4-1A and hypothesis 4-2A are supported. We consider that patents help to reduce financing constraints more effectively by promoting relationship banking or alleviating the hold-up problem in regions where financial offices dully compete.

VI. Conclusion

In SME financing, financial institutions like banks play an important role, because the financial dependence of SMEs on banks is higher than for large firms. In recent years, policies to promote SMEs finance utilizing intellectual property have been established in Japan. Further, recently, financial institutions are becoming more important in regional policy in Japan because it is gradually becoming clear that innovation projects to promote regional development have constrained finance. Comparing the regional financial industry trends by city size, we find the larger the city, the larger and more agglomerated the financial offices and the more competitive the environment of financial institutions.

In this context, we analyze the effect of regional financial concentration and competition on SME growth and survival to indirectly clarify how regional financial concentration and competition affect SME financing. Furthermore, we analyze the relationships between regional financial concentration, competition and the effect of patents on SME growth and survival to indirectly clarify the effect of patent application on the relationship between the regional finance situation and SME financing.

As the results, firstly, regarding the effect of regional financial concentration and competition on SME growth and survival, we suggest that regional financial concentration increases the risk of exit for SMEs and regional financial competition slows down SMEs' growth and increases the risk of exit for SMEs. We consider relationship banking rather than financing cost reduction as important for SMEs' growth and survival. Considering the regional financial environment in Japan, SMEs in smaller cities grow rapidly and reduce the risk of exit by utilizing relationship banking more easily. This may suggest that the Japanese policy which promotes regional relationship banking is effective.

Secondly, regarding the relationships between regional financial concentration, competition and

the effect of patents on SMEs growth and survival, we confirm that regional financial concentration reduces the patent negative effect on SME survival and regional financial competition decreases the patent positive effect on SME growth and increases the patent negative effect on SME survival. These results suggest that patents help to reduce financing constraints more effectively in regions where financial offices are more concentrated and reduce financing constraints more effectively by promoting relationship banking or alleviating the hold-up problem in regions where financial offices dully compete. So, future research should elucidate how these findings are caused to make policies to promote SME finance utilizing intellectual property more efficiently.

Finally, we describe some directions for future research. One is the improvement of analysis, for example, using financing data for direct analysis, adopting more suitable analysis methods like panel analysis. The other is adding further analysis points of view, for example, entry-rate.

References

- Angelini, P., Di Salvo, R. & Ferri, G., 1998. Availability and cost of credit for small businesses: Customer relationships and credit cooperatives. *Journal of Banking & Finance*, 22(6–8), pp.925–954.
- Berlin, M. & Mester, L.J., 1999. Deposits and Relationship Lending. *Review of Financial Studies*, 12(3), pp.579–607.
- de Guevara, J.F. & Maudos, J., 2009. Regional Financial Development and Bank Competition: Effects on Firms' Growth. *Regional Studies*, 43(2), pp.211–228.
- Kulatilaka, N. & Lin, L., 2006. Impact of Licensing on Investment and Financing of Technology Development. *Management Science*, 52(12), pp.1824–1837.
- Levitas, E. & McFadyen, M.A., 2009. Managing liquidity in research-intensive firms: signaling and cash flow effects of patents and alliance activities. *Strategic Management Journal*, 30(6), pp.659–678.
- Lutz, E. et al., 2013. Importance of spatial proximity between venture capital investors and investees in Germany. *Journal of Business Research*, 66(11), pp.2346–2354.
- Martin, R. et al., 2005. Spatial Proximity Effects and Regional Equity Gaps in the Venture Capital Market: Evidence from Germany and the United Kingdom. *Environment and Planning A*, 37(7), pp.1207–1231.
- Munari, F., Odasso, M.C. & Laura, T., 2011. patent-backed finance. In F. Munari & R. Oriani, eds. *The Economic Valuation of Patents: Methods and Applications*. Edward Elgar, pp. 309–336.
- Rajan, R.G., 1992. Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt. *The Journal of Finance*, 47(4), pp.1367–1400.