Ownership Structure and R&D

(Abstract)

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Research and development (R&D) leads to the technical progress and development of firms. This Thesis argues the relationship between R&D and ownership structure along the life cycle of firms: from start-up stage through IPO to listed stage of corporations. There have been many previous studies on the determinants of R&D using economic approach. Several studies developed a contention along the Schumpeterian Hypotheses, which proposed that the firm size and the market structure would largely affect the R&D. However, there are only a few studies that emphasize the relationship between R&D and the ownership structure in detail.

R&D investments have higher risk compared to other types of investments. Thus, the R&D investment, which is essentially accompanied by high risk, is constrained by the availability of internal funds. However, such financial constraints can be mitigated by certain types of external funds.

There have been few studies that focus on the relationship between R&D and ownership structure in different development stages of firms. The development of firms has different stages: firms undergo the start-up stage, initial public offering (IPO) stage and listed stage. The firms of different development stages play different roles in the innovation and the development of an industry. For each

development stage, financial constraints and ownership structure of firms are different. This thesis focuses on R&D of firms and analyzes the relationship between ownership structure and R&D in different development stages.

For the firms in the stage from start-up to IPO, the risk of R&D is higher and the financial constraints and information asymmetry are more serious than for the firms in the listed stage. Here, we assume that venture capitalists (VC) play an important role in mitigating financial constraints and information asymmetry. In the post-IPO period, the information asymmetry and financial constraints still exist. However, the influence of VC decreases. For the firms in the listed stage, we assume that main banks can play an important role in mitigating financial constraints and information asymmetry.

This thesis focuses on the roles of VC and main banks, and analyzes their effect on R&D of the firms in different development stages. Thus, major characteristic of this thesis is that it estimates the influence of ownership structure of the firms on R&D at the start-up stage, IPO stage and listed stage.

However, if innovative firms tend to attract VC and main bank as the providers of capital, shareholding ratio by VC and main bank dummy are endogenous and we encounter the problems of simultaneity and reverse causality. In order to avoid those problems, we employ the instrumental variable estimation for the empirical analysis.

In chapter 1, we analyze the influence of ownership structure on R&D investment of start-up firms. We argue that the type of large shareholders is an

important factor in promoting R&D investment under information asymmetry and that R&D projects, particularly those of start-up firms, strongly depend on the finance received from VC.

The dependent variable LOGRD is the natural logarithm of R&D intensity that is defined as the ratio of R&D expenditures to sales. Here, ownership structure is characterized by the VC relationship and the shareholding by the business corporations of the start-up firms. Other firm-level factors include firm size, capital structure and CEO's educational background. In order to inspect that VC have a different influence on R&D investment in differ industries, we analyze the software development, manufacturing, construction and wholesale-retail industries.

Our sample comprises 808 small start-up firms from software development and manufacturing, construction and wholesale-retail industries in Japan that were incorporated between 1990 and 1999 and for which the R&D expenditures data is available. All the data, with the exception of patent data, are obtained from the COSMOS company database of Teikoku Databank—a major credit research institute in Japan—for the fiscal years 2002 or 2003. We employ the instrumental variable estimation for the empirical analysis. We find that the shareholding by VC have a positive and significant impact on the R&D intensity of the software development, manufacturing industries that have higher R&D intensity.

In chapter 2, the effects of ownership structure on the patent applications of start-up firms are examined, focusing particularly on the role of VC. It is concluded whether VC have an incentive to support and promote patent applications in order

to increase market valuations of these firms. Further, we conclude whether shareholding by VC is supposed to have a positive effect on the patent applications brought by R&D expenditures.

A unique dataset of Japanese start-up firms is used in the analysis, controlling for firm and industry characteristics. The sample used in this chapter comprises 782 small start-up firms selected from among the software development, manufacturing, construction, wholesale, retail and other industries in Japan. The firms in the sample are incorporated between 1990 and 1999, the R&D expenditures data is available for them.

The dependent variables are the natural logarithm of number of patent applications plus one (PAT) and the dummy for patent applications (PATD) in the period 2003-2005. The explanatory variables comprise factors of ownership structure as well as other firm-level and industry-level factors for the years 2002 and 2003. We employ the Tobit Model with endogenous regressors (IVTOBIT Model) and the Probit Model with endogenous Regressors (IVPROBIT Model) for the empirical analysis. We find that shareholding by VC have a positively significant impact on patent applications.

In chapter 3, we analyze the effect of IPOs on R&D investment and discuss the change in the role of VC in the pre- and post-IPO periods. We also estimate the relationship among syndicating VC and the R&D investment of Japanese firms in the pre- and post-IPO periods.

The dependent variables are the R&D intensity defined as the ratio of R&D

expenditures to sales (RD). The R&D intensity is regressed to the factors of ownership structure, other firm-level factors and industry factors, using a firm-level cross-section sample. We employ the Tobit Model with endogenous regressors for the empirical analysis.

We obtain data about 298 firms for the years 1999, 2000 and 2001, respectively. Our dataset includes data on R&D expenditures, sales, cash flow, debt, and total assets and data on shareholding by all VC, financial institutions, and non-financial business corporations.

It is observed that the IPOs of firms were positively correlated with R&D investment in the post-IPO period and that shareholding by VC is positively correlated with R&D investment in the pre-IPO period. In addition, it is observed that syndicating VC have a higher effect on the R&D investment in the pre-IPO period than non-syndicating VC.

In chapter 4, we analyze the effect of governance determinants such as main bank relationship on R&D investment and test for changes in that effect on the grounds of the deterioration of the main bank relationship in the post-bubble period.

We use the natural logarithm of R&D intensity (ratio of R&D expenditures to sales: RD) as the dependent variable. We use cash flow ratio, debt ratio, the total assets, the shareholding ratio by top 10 shareholders, the main bank dummy variable, its intersection terms with cash flow ratio and debt ratio as independent variables. We employ the instrumental variable estimation for the empirical

analysis.

We target the analysis on the listed firms of the general machinery industry, transportation equipment industry, electrical machinery industry, chemical industry, and pharmaceutical industry, which cover more than 75% of the total amount of R&D investments of all industries. We compare the 1976–84 pre-bubble and the 1993–98 post-bubble periods.

According to the estimation results, during the pre-bubble period of 1976–84, the main bank relationship had an encouraging influence on R&D investment, whereas in the post-bubble period of the 1990s, such an influence significantly deteriorated. Moreover, the analysis of both periods indicated that the concentration of shareholding had no encouraging effect on R&D investment.

In conclusion, we find out that (1) shareholding by VC firms have a positive and significant impact on R&D investment of the industries that have higher R&D intensity, (2) VC have an incentive to patent applications of start-up firms in order to increase firm's market valuations, (3) the IPOs of the firms can mitigate the financial constraints on R&D investment, VC shareholding is positively related to the R&D investment in the pre-IPO period, and syndicating VC have a higher effect on the R&D investment than non-syndicating VC in the pre-IPO period, though not in the post-IPO period, (4) the main bank relationship has an encouraging influence on R&D investment of large listed firms in the pre-bubble period of 1976–84, though not during the 1990s.

Here, we state some limitations of our study. First, our samples may be limited

and biased, because they comprise the firms for which R&D expenditure data is available in those chapters 1, 2 and 4. Second, we use different samples for each development stage. Therefore, the empirical results of the different stages are not directly comparable.

According to the analysis conducted in this thesis, the main bank relationship served as an important governance determinant of R&D investment in the pre-bubble period of large listed firms. For the firms in the stage from start-up to IPO, VC play an important role in mitigating financial constraints and information asymmetry.

However, in recent years, main bank relationship, as a governance factor, has little influence on R&D investment of the listed firms. Shareholding by VC loses its impact on R&D investment after IPO. Thus, our results suggest that, at least in the post-bubble period, R&D investment is no more influenced by governance structure, but the financial constraints still exist.

R&D investment of large, listed firms is very important for the innovation in Japanese industries. Thus, the questions remain for future research how to organize a governance system that makes the large, listed firms possible to secure an essential fund, encourage it to perform optimal amount of R&D investment and improve the quality of their R&D project.