

# **Shareholding by venture capitalists and R&D investment of start-up firms**

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## Abstract

We analyze the influence of ownership structure on the R&D (research and development) investment of start-up firms. Previous studies on the relationship between ownership and R&D have targeted on large listed firms and focused on ownership concentration, regardless of the types of large shareholders. We argue that shareholder's type is an important factor of R&D investment under asymmetric information, and that R&D projects, particularly those of start-up firms, strongly depend on the financing from venture capitalists (VCs). Using a unique dataset of Japanese start-up firms, we find that the shareholding by VCs have, in fact, positively affects the R&D investment and that the impact of VCs funding is especially large when the shareholding by the lead VC exceeds 10%.

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## 1. Introduction

In Japan, small and medium enterprises (SMEs), once regarded as “weak”, low-tech firms and hence as the targets of protective policies, have recently been attracting considerable attention as the promoters of innovation (Small and Medium Enterprise Agency, 2004). Start-up firms, including new ventures that enter the markets with new products and services based on new technologies and ideas or discover new markets have been the center of attention. Although large and mature firms also play a significant role in innovation, the contribution made by start-up firms cannot be ignored (Acs and Audretsch, 2003).

However, there is insufficient information about the R&D (research and development) activities of start-up firms. Therefore, in-depth studies on the determinants of R&D in start-up firms have not been carried out. Previous studies have almost exclusively focused on large and mature firms. Nevertheless, due to increased expectation on start-up firms as promoters of innovation, the examination of the factors that encourage R&D in start-up firms is warranted.

With regard to the Schumpeterian Hypotheses, major previous studies have examined the effects of firm size and market structure as well as technological characteristics of industries on R&D and innovation. Other lines of studies stress the importance of financial structure for R&D and argue that R&D investment is constrained by the availability of internal funds under uncertainty and informational asymmetry (Acs and Isberg, 1991; Himmelberg and Petersen, 1994; Hall, 2002) or focus on regional factors such as agglomeration effects and knowledge spillovers (Roper 2001, Bagella and Becchetti, 2002; Smith et al., 2002; Beaudry and Breschi, 2003).

However, surprisingly few studies have been conducted on the effects of ownership or governance structure on the R&D activities (Hill and Snell, 1988; Hosono et al., 2004; Lynskey, 2004; Da Rin and Penas, 2007). A few existing studies focus on large and established firms, even though it is the small start-up firms that are expected to face more difficulties in financing their R&D activities.

Moreover, these studies stress the positive effects of monitoring by large shareholders on the R&D investment. They argue that a higher concentration of shareholding results in strong monitoring by large shareholders and thus increases the R&D intensity. In contrast, we argue that, even though strong monitoring by large shareholders does exist, it does not necessarily increase the R&D investment. First,

large shareholders may rather protect managers from the pressure of the capital market. Second, as a result of efficient monitoring, they may suppress inefficient R&D projects. Third, if large shareholders are risk averse, they prevent managers from carrying out risky R&D projects.

In this paper, we will argue that the type of large shareholders, rather than their pure existence, is crucial as the determinant of R&D by start-up firms. Special attention is paid to venture capitalists (VCs) as large shareholders in relatively R&D intensive industries.

The remainder of this paper is organized as follows. Section 2 discusses the effects of ownership structure on the R&D investment, focusing on start-up firms. Section 3 explains the estimation model. Section 4 describes the data. Section 5 presents the empirical results and discusses their implications. Section 6 concludes the paper, presenting some limitations of this study and making suggestions for further research.

## 2. Literature review and hypotheses

Major previous studies on the relationship between corporate governance and R&D intensity have focused on the role of large shareholders as a whole in large, established corporations. Hill and Snell (1988) and Hosono *et al.* (2004) argue that a higher concentration of shareholding results in strong monitoring by large shareholders, thus increasing the R&D intensity. Along a similar line, Hansen and Hill (1991), Hall and Weinstein (1996), and Wahal and McConnell (2000) empirically contradict the popular view that large institutional shareholders have a damaging impact on the R&D investment due to myopic profit pressures. As opposed to these studies, we focus on small start-up firms and argue that the type of large shareholders is important rather than the concentration of shareholding.

Start-up firms are more likely to suffer from financial constraints than mature firms because the problem of informational asymmetry is particularly serious for them (Denis, 2004). Indeed, the possibility of receiving external funding is much more restricted for them than for the large, established firms listed on the stock market. Thus, their investment is strongly constrained by the availability of internal funds (Colombo and Grilli, 2007). This is particularly the case with R&D investment, for which the risk is higher and the informational asymmetry is more serious than the other types of investments (Honjo *et al.* 2010). In the following part, we argue that the relationship with VCs can mitigate the financial constraints and thus promote R&D investment of

small start-up firms<sup>1</sup>. Moreover, VCs may also directly stimulate and support their R&D activities (Da Rin and Penas, 2007).

Gompers (2004) defines VCs as independent and professionally managed and dedicated pools of capital that focus on an investment that has a higher risk, but that potentially produces a higher profit. VCs can expect large capital gains from the initial public offering (IPO) of their portfolio firms and can thus stimulate and promote the innovative activities of the portfolio firms if this leads to an early and successful IPO. In this sense, VCs have incentive to promote risky R&D investment by portfolio firms.

VCs are often large shareholders of the firms in which they invest and therefore can often appoint and dismiss the directors of these firms (Hellmann, 1998). Moreover, VCs are experienced in mentoring young and innovative firms and also possess expert knowledge in some technological fields. Therefore, they can support and lead the managers of portfolio firms by using their specialized experience and expertise (Sahlman, 1990). Thus, VCs have not only the incentive but also the power and ability to promote the innovative activities of portfolio firms. Hellmann and Puri (2000) support this view and indicate that VCs participate in the innovative strategy of high-tech start-up firms.

Despite the increasing attention to VCs, only a few studies have focused on the relationship between the shareholding by VCs and innovation. Kortum and Lerner (2000) obtain robust evidence supporting the fact that VC investment has a strong and positive impact on patent applications. Using data of Japanese start-up firms, Lynskey (2004) finds positive and significant impact of VC funding on the number of patent applications and new productions. Engel and Keilbach (2007) also demonstrate that VC-backed firms are more innovative with regard to patent application than the control group but that these firms were innovative even before the VC funding. After the funding by VCs, no significant differences in patent applications can be found between the two groups. Hence, they argue that VCs do not promote innovation, but select innovative firms.

Using a large dataset, Da Rin and Penas (2007) analyze the impact of VC funding on various innovation strategies of Dutch firms, focusing on R&D outsourcing, but they are not interested in the intensity of in-house R&D that may be crucial for

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<sup>1</sup> Using Japanese data, Okamuro (2009) and Honjo *et al.* (2010) investigate the determinants of R&D intensity or R&D investment of start-up firms. However, they do not explore the role of VCs because of data constraints.

research-intensive start-up firms. Moreover, the funding by VCs is measured only as a dummy variable and not as their shares; hence the relative importance of VCs in the funding of start-up firms cannot be explored.

In this paper, we analyze the impact of the shareholding by VCs on R&D investment by start-up firms. Thus, we examine its impact on the innovative input rather than the output. Innovative output measured by the number of patent applications depends not only on the incentives and constraints on the R&D investment, but also on the efficiency of R&D and the incentives to patent innovative outcomes. All of these aspects can be affected by VC funding and other factors. In this paper, we focus on the impact of VC funding (measured both as discrete and continuous variables) on the incentives and constraints on the R&D investment and thus use the R&D intensity as the dependent variable.

Based on the above discussion, we propose the following hypothesis.

**Hypothesis 1: Shareholding by VCs positively affects the R&D intensity of start-up firms.**

VCs often invest in their portfolio firms by forming a syndicate with other VCs in order to share risks. In such cases, the VC that plays the most important role in monitoring and supporting portfolio firms among the syndicated VCs is called *lead VC*. Therefore, we should focus on the incentive and ability of the lead VC to monitor and support the portfolio firms. A substantial shareholding in the portfolio firms indicates substantial commitment. Moreover, if the ratio of shareholding exceeds a certain level, this large shareholder obtains the particular right to monitor the management of the portfolio firms<sup>2</sup>. Thus, focusing on the role of the lead VC, we propose the second hypothesis.

**Hypothesis 2: If shareholding by the lead VC is substantial, its impact on the R&D intensity of start-up firms is larger than the cases with lower share of the lead VC.**

The major contributions of this paper can be summarized as follows: First, we focus on small start-up firms in investigating the determinants of R&D intensity as the measure of R&D input. Second, in focusing on VC funding, we do not only compare VC-backed firms with the others, but also consider the relative importance of VC funding measured as the shareholding ratio. Particular attention is paid to the role of lead VCs. Third, whereas most previous studies neglect the endogeneity of VC funding,

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<sup>2</sup> As we explain later in detail, we set this level at 10% according to the Japanese Corporation Law and the distribution of shareholding data in our sample.

we directly cope with this problem by instrumental variable estimation.

### 3. Estimation strategy

We estimate the effects of ownership structure on the R&D intensity of start-up firms by using the following model:

$$RD = f(\textit{Ownership Structure}, \textit{Other Firm-level Factors}, \textit{Industry Factors}).$$

The dependent variable RD is R&D intensity defined as the ratio of R&D expenditures to sales. In the estimation, we use natural logarithm of R&D intensity considering its skewed distribution. As we explain later, our sample comprises only the firms with positive values of R&D expenditures. Using a firm-level cross-section sample, R&D intensity is regressed on the factors of ownership structure, other firm-level factors, and industry factors.

However, if innovative firms tend to attract VCs as the providers of capital, shareholding by VCs is endogenous and we encounter the problem of reverse causality. In order to cope with this problem, we employ the instrumental variable estimation for the empirical analysis. The instrumental variables are the ratio of shares held by individual shareholders (IND) and the ratio of 1 to the distance of the firms to Tokyo (DIS). We discuss later these instruments in more detail.

Here, ownership structure is characterized by the VC relationship. Other firm-level factors include firm size (SIZE), the ratio of debt to total assets (DEBT), and CEO's educational background (UNIV). Industry factors are represented by the industry (sector) dummy variables for construction, manufacturing, software development, wholesale/retail, and the other sectors. According to the purpose of this paper, we focus on the factors of ownership structure (particularly the relationship with VCs) and regard the other factors as control variables. The definitions of these variables are summarized in Table 1.

With regard to the ownership structure, the VC relationship is represented by the variables VCD, VCSH, LVCSH, and LVCD. VCD is the dummy variable for the shareholding by VCs, which takes on the value one if at least a VC is found among the ten largest shareholders. VCSH is the ratio of the total shares held by all VCs to total shares held by the reported large shareholders. LVCSH is the ratio of shares held by the

lead VC to total shares held by the reported large shareholders<sup>3</sup>. LVCD is the dummy variable for the shareholding ratio by lead VC, which takes on the value one if the shareholding ratio by the lead VC (LVCSH) is 10% or higher, and zero otherwise.

According to the Japanese Corporation Law enacted in 2005, if a shareholder holds 3% or more of the total shares, he has the right to claim for calling a general meeting (Article 297), to claim the assignment of an inspector who investigates operational and financial situation of the corporation (Article 358), to inspect accounting books and records (Article 433), and to claim the dismissal of directors or auditors (Article 854). Further, if his shareholding ratio exceeds 10%, he has the right to claim a dissolution judgment of the corporation (Article 833)<sup>4</sup>. The average shareholding ratio by the lead VC is 13.6% for VC-backed firms in our sample. Therefore, lead VCs could play a significant role in the governance of the majority of the VC-backed sample firms with their substantial shareholding.

These variables of VC shareholding are used interchangeably in the estimation. Based on the discussion in the previous section, we expect that these variables have all positive impacts on the R&D intensity. Therefore, if the estimated coefficients of these variables are positive and statistically significant, Hypothesis 1 will be regarded as supported. Moreover, if the coefficients of VCD and LVCD display positive and significant values, and the normalized value of the coefficient of LVCD is larger than that of VCD, Hypothesis 2 is regarded as supported.

We do not use any other variables of ownership structure, such as the shareholding ratios by banks. In fact, banks hardly invest in start-up firms. Moreover, as we argued before, we do not expect that the R&D investment monotonically increase with the concentration of shareholding.

DEBT is a variable that indicates the effect of debt ratio on R&D investment. If the debt ratio is high, the firm is supposed to refrain from R&D investment because of the debt-overhang problem<sup>5</sup>.

With regard to the other firm characteristics, we use the variables SIZE and UNIV in the estimation model. SIZE is measured as the natural logarithm of the number of

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<sup>3</sup> Because we cannot identify the lead VC from our data, for simplicity, we regard the VC holding the largest share among all VCs as the lead VC in this paper.

<sup>4</sup> The same rights were provided in the Japanese Commercial Law until 2005, so that these rights apply to our sample firms. The lowest shareholding ratio that provides the right to inspect accounting books and records was changed in 1993 from 10% to 3%.

<sup>5</sup> Cf. Myers (1977) for research on discouraging effects of debt on R&D investment.

employees and is used as a proxy for firm size. According to the Schumpeterian Hypotheses, larger firms carry out over-proportionally high R&D investment. This is because, as compared to smaller firms, larger firms have more internal funds, more opportunities to procure external funds, higher ability to take risks, and more complementary resources (production, marketing, etc.) for implementing innovation. Therefore, we have to control for the firm size effect.

UNIV is the dummy variable that takes on the value of one if the current CEO is a university graduate and zero otherwise. This variable is used as a proxy for the educational background of the CEO. We argue that the educational level of the CEO may influence the technological orientation and innovativeness of a firm, thereby influencing the R&D investment of start-up firms (Scherer and Huh, 1992; Lynskey, 2004; Okamuro, 2009).

As instruments for the VC variables, we use the ratio of shares held by individual shareholders (IND) and the ratio of 1 to the distance of the firms to Tokyo (DIS).

The first instrumental variable is the ratio of shares held by the individual shareholders (IND). This ratio is high for firms owned by the founders and their family members (independent firms) and low for firms affiliated to business corporations (affiliated firms). Using this variable, we will control for the difference between the independent and affiliated firms. The former is expected to have lower probability to obtain external support than the latter because of informational asymmetry and insufficient business network. Therefore, we assume that it is more difficult for the independent firms to obtain support by VCs than for the affiliated firms. Thus, this variable is expected to be negatively correlated with VC variables but to have no obvious correlation with R&D intensity. Therefore, it can be regarded as an appropriate instrument.

Another instrumental variable is the ratio of 1 to the geographical distance of the firms to Tokyo (DIS). The farther portfolio firms are located, the more difficult it is for VCs to support and monitor the managers of portfolio firms by using their specialized experience and expertise (Lerner, 1995). Therefore, VCs are supposed to prefer firms in their proximity. Thus, we expect that this variable is directly correlated with VC variables but not obviously with R&D intensity. DIS is measured by the geographical distance in railway kilometers between the nearest railway station of the portfolio firms and the central station of Tokyo. The information about the distance was obtained from *Yahoo JAPAN*. We use the ratio of 1 to the distance of the firms to Tokyo (DIS) as an

instrumental variable, since the location of VCs is concentrated in Tokyo<sup>6</sup>.

As mentioned before, industry factors are represented by industry dummy variables. R&D intensity varies considerably across industries reflecting the differences in technological opportunities and the appropriability of innovative outcomes. It is well known that R&D intensity is particularly high in software development and manufacturing industries, and this tendency is supported by our data. Therefore, we include dummy variables for these industries (software development: D1, manufacturing: D2, construction: D3, and wholesale and retail: D4) to control for the differences in technological characteristics of industries, taking the other industries as the baseline reference.

#### 4. Data description

Our sample comprises 808 small start-up firms from the software development, manufacturing, construction, wholesale and retail, and other industries in Japan that were incorporated between 1990 and 1999 and for which R&D expenditure data are available<sup>7</sup>. The dataset was obtained from the COSMOS company database of Teikoku Databank—a major credit research institute in Japan—for the fiscal years 2002 or 2003<sup>8</sup>. Thus, the start-up firms in this study are those that have been incorporated for less than 12 or 13 years by the year 2003.

We obtained data of 1,040 firms from the database of Teikoku Databank with the above conditions. From these, we excluded 130 firms that belong to the restaurant and other service industries, listed corporations (11 firms), large firms with more than 300 employees (5 firms), the firms with missing values (83 firms) and distinct outliers (3 firms). Consequently, 808 firms were obtained as the final sample.

Our dataset is unique in that it includes only small and unlisted start-up firms on the one hand and combines financial and ownership data on the other. The dataset contains financial data such as sales and R&D expenditure; ownership data such as the names of the largest (up to 15) shareholders and the number of shares held by each of

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<sup>6</sup> In our sample, 51 firms were funded by VCs, and 44 of them have their lead VCs located in Tokyo.

<sup>5</sup> The date of establishment (foundation) is not reported for many firms. Therefore, we use the date of incorporation as the criterion for sample selection. This implies that our sample may include the firms that were established before 1990 but incorporated after 1990.

<sup>6</sup> The latest available data are from the fiscal year 2002 or 2003, depending on the dates of the financial statements and the investigations conducted by Teikoku Databank.

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them; number of employees, industry classification code, and the educational background of the CEO. However, cash flow data are not available, and thus we cannot use the important proxy for internal funds in our estimation.

It is also noteworthy that we cannot calculate precisely the ratio of shareholding by each large shareholder because our dataset provides only the number of shares held by each of the top 15 shareholders and not the total number of shares. Therefore, the ratio of the shareholding by VCs was calculated as the number of shares held by them divided by the sum of the number of shares held by the reported large shareholders. The shares of smaller shareholders including VCs, if any, are thus not considered. Therefore, these variables should be regarded as proxies. Sample statistics are presented in Table 2.

The mean value of R&D intensity is 0.00856, but the median is 0.00107. The descriptive statistics suggest that the distribution of the dependent variable is skewed to the left, and thus, we use the natural logarithm of R&D intensity in the empirical analysis. 6.3% of the sample firms are funded by VCs. Accordingly, the average values of VCSH and LVCSH are very small because they are calculated including those firms without VC funding.

The average number of employees is approximately 22.9 (2.479 in natural logarithm). 88.7% of the sample firms are independent firms whose founders and family members are the largest shareholders (the rest are subsidiaries of established business corporations). 38% of the CEOs are university graduates. The sample firms belong to software development (7.9%), manufacturing (12.9%), construction (33.7%), wholesale and retail (33.7%) and the other (11.9%) industries.

## 5. Empirical results and discussion

We employ the instrumental variable estimation, and present normalized beta coefficients. The empirical results are presented in Table 3. The variables of VCs are included interchangeably in the estimation models.

All of the ownership variables have positive and highly significant coefficients in all specifications. Thus, Hypothesis 1 is supported. Further, the normalized value of the coefficient of LVCD is higher than that of VCD. Hence, Hypothesis 2 is supported.

Almost none of the controlling variables have significant effects on the R&D intensity. These results suggest that, contrary to our expectation, these basic characteristics of firms have no impact on the R&D intensity, when VC funding (and its

endogeneity) is taken into consideration<sup>9</sup>. These results are partly consistent with those of Okamuro (2009) in that the CEO's educational background shows no significant effect on R&D activity of the Japanese start-up firms.

The signs and values of the estimated coefficients in Table 3 are also consistent with the simple correlation coefficients between the dependent and independent variables in Appendix.

In order to inspect the influence of VCs on the younger start-up firms, we analyze the 255 start-up firms that have been incorporated for less than six years by 2003. The empirical results of these firms reveal similar tendency to those of the entire sample, though the effects of VC funding is weaker<sup>10</sup>.

As a whole, the empirical results demonstrate that the shareholding by VCs has a positive impact on the R&D intensity of Japanese start-up firms. These results are at least consistent with our argument that, with financial support from VCs, start-up firms are able to secure funds for their R&D investment.

## 6. Concluding remarks

The purpose of this paper was to investigate the effects of ownership structure on the R&D intensity of start-up firms, focusing on the roles of VCs. Using a unique dataset of Japanese start-up firms and controlling for firm and industry characteristics, we found that the shareholding by VCs had a positive and significant impact on the R&D intensity, and the shareholding by the lead VC that is higher than 10% was especially important for the R&D investment.

Main contributions of this study include its focus on start-up firms on the one hand and the influence of VCs on the other. Previous studies on the determinants of the R&D intensity, from the viewpoint of ownership and corporate governance, have concentrated on large, listed firms and have rather ignored small start-up firms as the promoters of innovation. They have also stressed the effect of shareholding concentration rather than the roles of the specific types of large shareholders, such as VCs. We attempted to fill this gap and obtained empirical results that support our hypotheses. Moreover, we coped with the endogeneity problem by using instrumental variable estimation, which was not

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<sup>9</sup> With regard to firm size, we can argue that firm size effect may be evident between small and large firms but not so among small start-up firms.

<sup>10</sup> The results of this sub-sample analysis are available from the authors upon request.

considered in the previous studies.

In conclusion, we will mention some limitations of our study. First, our sample may be biased toward research-oriented start-up firms because it comprises only firms with positive R&D expenditure. Second, we estimated only the direct relationship between the variables of ownership structure and the R&D intensity and did not investigate the mechanism of how the shareholding by VCs affects the R&D intensity. In order to explore this mechanism, we should have included, for example, the ratio of cash flow to sales and its interaction term with the VC dummy. However, cash flow data were not available for our sample.

There have been relatively few empirical studies on the determinants of R&D and innovation of start-up firms. Focusing on the role of VCs, our paper can be regarded as the first step toward fruitful future researches in this field. Specifically, by considering and coping with endogeneity of VC funding, our research may contribute to the recent discussion of whether the VCs select innovative firms or support and encourage their portfolio firms to be innovative (Baum and Silverman, 2004; Jungwirth and Moog, 2004; Engel and Keilbach, 2007).

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**Table 1: Definitions of Variables**

Variables	Definitions
RD	Ratio of R&D expenditures to sales in natural logarithm
VCD	Dummy variable that takes on the value one if the firm's shares are partly held by VCs, and zero otherwise
VCSH	Total ratio of shares held by VCs to total shares held by the reported large shareholders
LVCSH	Ratio of shares held by the lead VC to total shares held by the reported large shareholders
LVCD	Dummy variable that takes on the value one if the value of LVCSH exceeds 10%, and zero otherwise
SIZE	Number of employees in natural logarithm
DEBT	Ratio of debt to total assets
UNIV	Dummy variable that takes on the value one if the CEO is a university graduate, and zero otherwise
D1	Dummy variable for software development industry
D2	Dummy variable for manufacturing industry
D3	Dummy variable for construction industry
D4	Dummy variable for wholesale and retail industry
<b>Instrumental variables for VC variables</b>	
IND	Ratio of shares held by individual shareholders (IND)
DIS	Ratio of 1 to the distance of the firms to Tokyo

**Table 2: Descriptive Statistics (N=808)**

Variables	Mean	Median	Std. Dev.	Minimum	Maximum
RD *	0.00791	0.00107	0.0285	0.0000202	0.359
VCD	0.0631	0	0.243	0	1
VCSH	0.0159	0	0.0727	0	0.628
LVCSH	0.00858	0	0.0416	0	0.459
LVCD	0.0322	0	0.177	0	1
SIZE	2.48	2.38	1.10	0	5.69
DEBT	0.848	0.890	0.164	0.180	1
UNIV	0.380	0	0.486	0	1
D1	0.0792	0	0.270	0	1
D2	0.129	0	0.335	0	1
D3	0.337	0	0.473	0	1
D4	0.337	0	0.473	0	1
IND	0.572	0.780	0.446	0	1
DIS	0.137	0.00298	0.218	0.000586	0.500

\* We present the descriptive statistics of R&D intensity in original values in this table, while we use natural logarithm of R&D intensity in the empirical analysis.

**Table 3: Estimation Results**

(Instrumental Variable Estimation)

Dependent variable = RD; N=808

Variables/Models	1	2	3	4
VCD	0.0595 (3.69) a			
VCSH		0.229 (3.41) a		
LVCSH			0.421 (3.38) a	
LVCD				0.0855 (3.12) a
SIZE	0.000575 (0.22)	0.000687 (0.25)	0.000435 (0.16)	0.00163 (0.58)
DEBT	0.0162 (1.57)	0.0164 (1.57)	0.0165 (1.58)	0.0115 (1.16)
UNIV	0.000703 (0.30)	-0.000355 (-0.15)	-0.000750 (-0.30)	-0.000590 (-0.23)
D1	0.0109 (1.34)	0.0111 (1.34)	0.0109 (1.31)	0.0158 (1.88) c
D2	0.000153 (0.03)	0.0112 (0.11)	-0.000260 (-0.05)	0.000110 (0.02)
D3	-0.00142 (-0.44)	-0.00201 (-0.61)	-0.00251 (-0.79)	-0.00190 (-0.58)
D4	-0.00103 (-0.26)	-0.00106 (-0.27)	-0.00141 (-0.37)	-0.00150 (-0.37)
Constant	-0.0105 (-1.05)	-0.0101 (-1.02)	-0.00939 (-0.97)	-0.00669 (-0.69)
<b>Adjusted R-squared</b>	<b>0.0737</b>	<b>0.0213</b>	<b>0.0904</b>	<b>0.0752</b>

1) Level of significance: a 1%, c 10%.

2) T-statistics in parentheses.

## Appendix: Correlation Matrix (N=808)

Variables	RD	VCD	VCSH	LVC SH	LVCD	SIZE	DEBT	UNIV	IND	DIS
RD	1									
VCD	0.308	1								
VCSH	0.294	0.842	1							
LVC SH	0.287	0.795	0.915	1						
LVCD	0.234	0.703	0.849	0.868	1					
SIZE	0.126	0.202	0.117	0.149	0.153	1				
DEBT	-0.0768		-0.296	-0.194	-0.245	-0.256	-0.158	1		
UNIV	0.0722		0.111	0.103	0.127	0.122	0.0448	-0.0549	1	
IND	-0.0827		-0.333	-0.252	-0.265	-0.280	-0.268	0.119	-0.181	1
DIS	0.0511	0.155	0.121	0.0941	0.122	0.0105	-0.0479	0.159	-0.143	1

\* Industry dummy variables are omitted from this table.