R&D and Insider Shareholding

Feng-Li Lin[1]

[1] Department of Accounting, Chaoyang University of Technology, Twiwan, R.O.C

Correspondence: Feng-Li Lin, Department of Accounting, Chaoyang University of Technology, No. 168 Jifong E. Rd., Wufong District, Taichung, 41349, Taiwan, R.O.C. Tel: 886-4-2332-3000 ext.7421. Fax: 886-4-2374-2359. E-mail:bonnie@gm.cyut.edu.tw

Received: February 14, 2014 Accepted: March 15, 2014 Online Published: March 18, 2014

doi:10.5430/afr.v3n2p51 URL: http://dx.doi.org/10.5430/afr.v3n2p51

Abstract

The purpose of this paper is to identify the optimal levels of insider shareholding and R&D spending, as a means of alleviating conflicts between managers and shareholders. This study analyzed whether insider shareholding affected R&D spending, employing a panel of 252 Taiwanese listed electronics companies, over a decade (2002–2011) term. When insider shareholding was less than 13.84%, R&D spending decreased by 0.05386% for each 1% increase in insider shareholding; When insider shareholding was more than 13.84%, R&D spending increased by 0.0275% for each 1% increase in insider shareholding. These results suggest that insiders holding a big part of equity were controlled by ultimate controllers related to family conglomerates, who generally have an incentive to decide R&D spending up to the maximum value of stockholders.

Keywords: R&D spending, Insider shareholding, Ultimate controllers, Stockholders

JEL classification: G31, G32, G34

1. Introduction

Investment in research and development (R&D) is expected to get knowledge to speed the development of businesses and the economic system comprehensively. Almost all well-known international firms consider R&D investment as their "blood". The scale of R&D activities is a valuable criterion in measuring the value and competitiveness of a firm. Guellec and Van-Pottelsberghe (2001) found that a 1 percent increase in R&D stock would contribute a 0.13 percent increase in the development of multiple factor productivity for 16 OECD countries. The significance of R&D spending has obtained increasing attention from decision-makers for strategic management. The size and distribution of R&D investment is at the discernment of upper administrators. Therefore, the quantity of R&D spending relies on the risk aversion and preferences of managers. Similarly, boards of directors and supervisors can indeed influence R&D spending by actively attending, supervising, and proving the R&D investment decisions of executives, making sure that only stockholder value-plus projects are employed.

Agency theorists have indicated that in companies with high insider shareholding, managers are more possibly to make R&D investment decisions to maximize the value of stockholders. But, considering managerial opportunism and varies interests of managers and stockholders, agency theorists have argued that R&D investing mayn't be mainly aimed at increasing stockholder value. Managers may fulfill R&D investment to increase their individual interests at the cost of stockholders' interests. Insider shareholding is available to ally executives' and stockholders' interests; the bigger the insider shareholding, the lower agency costs are possibly to be (Jensen and Meckling, 1976; Kroll et al., 1997).

This study attempted to identify the optimal levels of insider ownership that affect R&D investment, based on insider shareholding and R&D investment sensitivity, as a means of alleviating conflicts between managers and shareholders. The results showed that the relationship between insider shareholding and R&D spending was negative for shareholding levels below 13.84%, and positive for levels above 13.84%, and varied in speed when they were in various ranges. The other in this study is classified into 4 parts. Part 2 shows the results of former empirical research. Part 3 indicates the methodology, the sample data and the variables. Part 4 is the discussion of the results. Part 5 are conclusions and some implications resulting from the findings.

2. Ownership Structure and R&D

Managers play a significant status in shortening managerial opportunism (Fama and Jensen, 1983) that influences the relationship between firm performance and R&D investment (Tihanyi et al., 2003). Agency problems arise within a firm because of conflicts of interest and information asymmetry between managers and shareholders (Fama and Jensen, 1983). Two conflicting views address the link between R&D investment and ownership structure, namely, managerial myopia and information asymmetry. R&D investments involve a high risk and high failure rate, and expert's investing agencies assess the firm value, placing less emphasis on the intangible assets that result from R&D investments (Laverty, 1996). Thus, managers can't tolerate high risks because their job compensation and safety are associated with the firm performance during their contract period (Kor, 2006). Therefore, to receive a favorable salary and protect their works, managers prefer not to take the risk of R&D investment in the long term (managerial myopia), thus, managerial opportunism has been recognized as a barrier to R&D spending. At the same time, information asymmetry may also exist, in which outsider stockholders have difficulties collecting information on the strategic actions of the firm (Jensen and Meckling, 1976) and the character of the R&D investing (Myers, 1984). Publication of information about the R&D plans would set the company at a competitive shortcoming, because this information could be useful to its competitors (Bhattacharya and Ritter, 1983). Therefore, information asymmetry between managers and stockholders would cause the unsuitable assessment of R&D spending (Lee and ONeill, 2003).

Agency theorists have indicated that insider shareholding is available to line up the interests of managers and stockholders, and that the bigger the insider shareholding, the lower agency costs are possibly to be (Jensen and Meckling, 1976; Kroll et al., 1997). In companies with high insider shareholding, managers are more possibly to make R&D investment determination to maximize the stockholders' value. But, agency theorists have argued that the different interests between managers and stockholders and managerial opportunism, R&D spending may not be mostly embattled toward rising stockholder value. Managers may carry out R&D investment to put up their individual interests at the expense of the interests of stockholders. They may employ R&D efforts to generate new, sales-improving products, which increasing firm's size, and in other word, their compensation and position (Brush et al., 2000). Many studies have revealed both positive and negative relationships between shareholding and R&D investing. Studies on the relationship between shareholding and R&D investing have not reached consistent conclusions. Employing panel data of U.S. family-owned and non-family-owned companies, Block and Thams (2008) found that family-owned firms were no more long-period oriented than non-family-owned companies. Kim et al. (2008) indicated that controlling shareholders promoted R&D investment in Korean companies. Nevertheless, Yang and Huang (2005) found that R&D investing in the Taiwanese electronics industry had a positive effect on jog increase in the long period, whereas short-period effects were found to be considerably less significant. O' Connor et. al. (2013) found that the relationship between equity compensation and lower level of corporate R&D cost existed; compensation executives to get more peril little affect R&D cost but that for higher rewards decreased R&D cost, making it more sensitive to financial market frictions (FMF). Conversely, cash compensation lessens the sensitivity of R&D cost to FMF. Chan (2014) studied the intellectual-capital output influence on the asymmetric timeliness of firm earnings in Taiwan where there was an emerging market with higher R&D-intensive corporate but poorer investor' protection. This study showed that a negative relationship between asymmetric timeliness of firm earnings and innovation efficiency existed.

Adopting a cross section of Fortune 500 manufacturing companies in 1991, Cho (1988) found a similar non-monotonic relationship between insider shareholding and R&D spending. The relationship between insider shareholding and R&D investing was positive for shareholding levels below 7% and above 38%, and negative for levels between 7% and 38%, respectively. Similarly to the Cho (1998) study's findings, Cui and Mak (2002) also found a non-monotonic relationship between insider shareholding and R&D spending. They found that R&D spending initially declined as managerial shareholding increased less than 5%, and between 5% and 10%, respectively and declined between 10% and 15%. There was another increasing in R&D spending beyond 15% shareholding, in order that a W-shaped relationship existed. Ghosh et al (2007) found that R&D investment rose as CEO shareholding increased below 5%, decreased within the CEO shareholding range of 5% to 25%, and increased again but insignificant beyond 25%. The finding shows that the interest-effect convergence is major within low range of CEO shareholding, while the 5% to 25% shareholding regime demonstrates the entrenchment effect. Cosh et al. (2007) found that CEO shareholding positively affected innovative efficiency at low levels of shareholding, with the turning point lying between 65% and 68% of shareholding after which the effect turned negative. Hull et al.(2013) discovered that larger under-spending in R&D was related with larger values during the IPO stock value assessment. Bigger insider shareholding reduces led to inferior valuations in spite of the period of occasion. Larger R&D

under-spending and insider shareholding reduces them resulted in less under pricing.

3. Data and Methodology

3.1 Sample

I'd conducted my investigation via a panel of 672 Taiwanese listed electronics companies during a decade (2002–2011). All data were gotten from the Taiwan Economic Journal (TEJ) database of Taiwan. I eliminated 131 of 672 firms which were missing R&D expenditures data. I dropped an additional 273 firms and 16 firms from the sample because they were missing market value and insider shareholding data, respectively. The final sample was a panel of 252 Taiwanese listed electronics companies a decade (2002–2011).

3.2 Variables

The threshold variable, that is, insider shareholding (IS), the portion of shares, excluding options, held by the president and boards of directors and supervisors, is the main variable adopted to scrutinize whether there is a threshold effect of insider shareholding on R&D spending. R&D is measured as R&D spending divided by net sales. This study also incorporates control variables normally employed in examining R&D expenditures, namely, cash flow defined as the ratio of operating cash flow, investing cash flow, and financing cash flow to total assets (CF); the ratio of total liabilities to total assets (Leverage); the natural log of the book value of total assets (Size). This work follows La Porta et al. (2002) in measuring Tobin's Q as the book value of assets, minus the book value of equity and deferred taxes, add the market value of common stock, divided by the book value of total assets.

Table 1 presents the descriptive statistics for a total of 2,520 company-year observations. The average (median) value of R&D expenditures is 4.66 (2.35). The insider shareholding (IS) held by president and directors and supervisors of the board, on average (median), is 21.64% (18.86%) of all the shares. Basically, the change degree in insider shareholding each year over the sample term is small. The control variables, the ratio for Cash Flow is 1.2%, the ratio for Leverage is 35.89%, the pooled mean of Tobin's Q is 1.48; the size distribution of the sample company is also skewed by the big variances between mean (20,911 million NTD) and median (3,828 million NTD) total assets. The normality for whole variables is rejected via Jarque-Bera test.

Table 1. Sample descriptive statistics

Variables	Average	Max.	Min.	Std. Dev.	Median	Jarque-Bera
RD	4.66	90.00	0.00	7.79	2.35	118570.3***
IS	21.64	71.98	2.17	12.65	18.86	1036.052***
CF	1.20	174.12	-56.33	9.32	0.29	380090.7***
Leverage	35.89	97.40	1.82	15.88	35.71	42.11779***
TQ	1.48	15.28	0.18	1.02	1.21	67942.9***
Size ($millions)	20,911	1,181,868	131	64,689	3,828	765388.6***

Notes: *, **, ***Significant at the 10%, 5%, and 1% levels, respectively. Jarque-Bera Test for Normality. The sample size is a total of 2520 firm-year observations results. R&D is evaluated as R&D expenditures divided by the sales. IS, insider shareholding, is measured as the portion of shares, excluding options, held by the president and directors and supervisors of the board. Tobin's Q is defined as the book value of assets minus the book value of equity and deferred taxes add the market value of common stock divided by the book value of total assets. CF is measured as the ratio of operating cash flow, investing cash flow, and financing cash flow to total assets. Leverage is defined as the ratio of total liabilities to total assets. Size is measured as the total assets.

3.3 Panel unit-root models

The panel smooth transition regression model needs that the variables in the model be stationary so as to prevent spurious regressions. Therefore, I carry out the unit root test firstly. I employ the Levin–Lin–Chu (LLC) (2002), the Im–Pesaran–Shin (IPS) (2003), the Augmented Dickey–Fuller (ADF) (Dickey and Fuller, 1979) and the PP–Fisher Chi-square (Phillips and Perron, 1988) for the panel data. Table 2 shows the results of the stationary test of each panel, it is obvious that whole variables are stationary in that the nulls of the unit root are majorly rejected.

Table 2. Panel unit root test results

Method	LLC		IPS		ADF - Fisher Chi-square		PP - Fisher Chi-square	
RD	-85.1105	[0***]	-5.19872	[0***]	594.075	[0***]	689.246	[0***]
IS	-10497.3	[0***]	-693.152	[0***]	881.623	[0***]	1172.48	[0***]
CF	-26.2663	[0***]	-15.5835	[0***]	1204.24	[0***]	2488.88	[0***]
Leverage	-24.1597	[0***]	-4.98725	[0***]	718.387	[0***]	799.074	[0***]
TQ	-26.258	[0***]	-11.1638	[0***]	995.750	[0***]	1456.61	[0***]
Size	-16.2219	[0***]	-2.57703	[0***]	634.093	[0***]	1129.15	[0***]

Notes: The numbers in brackets indicate p-values. *, **, ***Significant at the 10%, 5%, and 1% levels, separately.

3.4 Panel Smooth Transition Regression Model

Based on González, Teräsvirta and Dijk (2004, 2005), I establish the panel smooth transition regression model in the following:

$$R\&D_{i,t} = \mu_i + \sum_{m=0}^{M} \sum_{k=1}^{K} \beta_{m,k} x_{i,t,k} f\left(IS_{i,t};\gamma, C_m\right) + \varepsilon_{i,t} \tag{1}$$

where the variables $x_{i,t,k}$ are $IS_{i,t}$, $CF_{i,t}$, $Leverage_{i,t}$, $Q_{i,t}$, and $Size_{i,t}$ for k=1 to 5, separately, and $h\left(IS_{i,t}, C_m\right)$ is one if $C_m \le IS_{i,t}$. The values of C_m are gotten from the regression with $C_0 = 0$.

The sign $f\left(IS_{i,t};\gamma, C_m\right)$ shows a transition function relying on the variables previously shown and in which C is the threshold parameter and γdecides the slope of the transition function.

The transition function $f\left(IS_{i,t};\gamma, C_m\right)$ is a enclosed and continual function of the threshold variable $\left(IS_{i,t}\right)$ and is normalized to be enclosed from 0 to 1, and the maximum values are related with regression coefficients β_0 and $\beta_0+\beta$. The value of $\left(IS_{i,t}\right)$ decides the value of $g\left(IS_{i,t};\gamma, C_m\right)$and therefore, the effective regression coefficients $\beta_0+\beta_1$, $f\left(IS_{i,t};\gamma, C_m\right)$for firm i at time t. According to Granger and Teräsvitra (1993), (1994) and Jansen and Teräsvitra (1996), the logistic transition function is used as follows:

$$f(IS_{i,t}:\gamma, C) = (1+\exp(-\gamma\prod_{j=1}^{m}(IS_{it}-C_j))^{-1}, \gamma > 0, C_1 \le C_2 \le \ldots C_m \tag{2}$$

The parameter γ affects the smoothness of the transitions and where $C = C_1, C_2, \ldots C_M$, is an M-dimensional vector of position parameters. Practically, it is typically enough to regard as m = 1 or m = 2, as these values permit for normally met alternative types of the parameters. When the m = 1 and $\gamma \to \infty$, the PSTR model is similar to panel threshold model of Hansen (1999). When the m = 2 and $\gamma \to \infty$, the model shows a three-range threshold model whose outer ranges are same and vary from the middle range. When m > 1 and $\gamma \to \infty$, the number of various ranges are still two, with the transition function switching in and out between zero and one at $C_1, \ldots, C_m$. At last, when $\gamma \to 0$, the transition function (2) turns into constant for any m value, in such case the model becomes a linear or homogenous panel regression model.

The begging specified term of the modeling cycle basically composed of homogeneity testing against the PSTR alternative. The PSTR model (1) with (2) can be decreased to a homogenous model via $H_0^2 : \beta_1 = 0$ or $H_1^2 : \gamma_1 = 0$. But the related tests are nonstandard in that under either null hypothesis the PSTR model consists of unidentified nuisance parameters. Then, according to Luukkonen, Saikkonen, and Teräsvirta (1988), this nuisance parameters are solved. Homogeneity test via the null hypothesis $H_{0:} : \gamma = 0$. Its first-order Taylor extension around γ=0 is used. This results in supplementary regression in the following:

$$R\&D_{i,t} = \mu_i + \beta_0^{*} x_{i,t} + \beta_1^{*} x_{i,t} IS_{i,t} + \ldots + \beta_m^{*} x_{i,t} IS_{i,t}^{m} + \varepsilon_{i,t}^{*} \tag{3}$$

Thus, testing $H_{0:} : \gamma = 0$ in (4) is equal to testing the null hypothesis $H_0 : \beta_0^{'*} = \ldots = \beta_m^{'*} = 0$ in (3). Notice that in the null hypothesis $\{\varepsilon_{it}^{*}\} = \{\varepsilon_{it}\}$, as a result the Taylor series estimate cannot affect the asymptotic distribution theory.

The homogeneity test is also available for deciding the suitable order m of the logistic transition function in (2). Granger and Teräsvirta (1993) and Teräsvirta (1994) projected a series of tests for selection between m = 1 and m = 2. Employing the supplementary regression (3) with m = 3, test the null hypothesis $H_0 : \beta_2 = \beta_1 = \beta_0 = 0$. If rejected, the linear test can be progressed as follows:

$$H_{04} : \beta_2 = 0; H_{03} : \beta_1 = 0, \beta_2 = 0; H_{02} : \beta_0 = 0, \beta_2 = \beta_1 = 0 \quad (4)$$

The PSTR model is a quite uncomplicated simulation of nonlinear least squares and the fixed effects estimator. If the rejection of H_{03} is the strongest one, then choose m = 2, otherwise m = 1. Following PSTR model decide the various-parameter types, continue with model parameter estimation.

4. Empirical Results

To examine whether the model is non-linear relationship, LM (chi-square statistic), LMF (F statistic), and LRT (T statistic) homogeneity tests are used. Table 3 indicates that this model is a non-linear model since the homogeneity test is rejected for the transition variable, the *p*-values are all significant at the 1% level. Afterward the series of homogeneity tests is employed to decide the logistic function of *m* order. Table 4 indicates the results for the order test series the F-Test for m, indicate *m* = 1 as the strongest rejection does exist for null hypotheses (H_{01}). In that case the testing results of the number of ranges are significant at 1% level, given the choices of maximin r =1. As a result, there is one threshold effect of insider shareholding on R&D investment derived from the robust test.

Table 3. Homogeneity tests

Transition variable	Test	*p*-value
Wald Tests (LM)	78.016***	0
Fisher Tests (LMF)	4.799***	0
LRT Tests (LRT)	79.249***	0

*Notes:****, **, and * show significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 4. Series of homogeneity tests for m

	F- Test	*p*-value
(m=3) $H_{03} : \beta_3 = 0$	1.078	0.372
(m=2) $H_{02} : \beta_2 = 0 \mid \beta_3 = 0$	1.103	0.347
(m=1) $H_{01} : \beta_1 = 0 \mid \beta_3 = \beta_2 = 0$	2.586***	0.0001

*Notes:****, **, and * show significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 5 shows the regression slope estimates and the T-value for two ranges. When there is an one threshold effect of insider shareholding on R&D investment, all observations are divided into two ranges. The estimated model from the empirical results is indicated in the following:

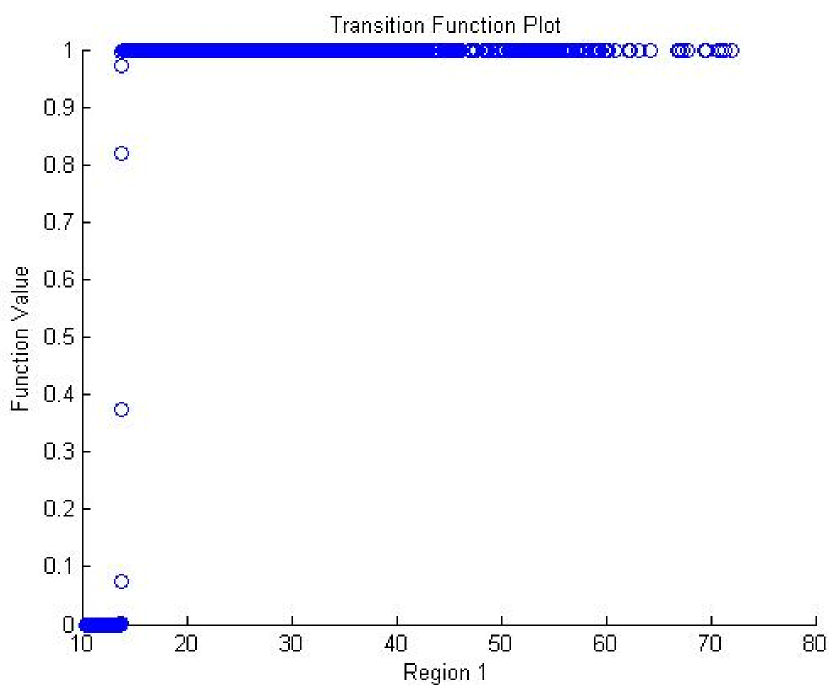
$$R\&D_{it} = (-0.3586IS_{it} - 0.0162CF_{it} + 0.0782Leverage_{it} - 0.0049TQ_{it} - 1.4645Size_{it}) + \\ + (0.3861IS_{it} + 0.0014CF_{it} - 0.0935Leverage_{it} - 0.0074TQ_{it} + 0.0106\mathrm{Size}_{it}) \\ f(IS, 13.84\%, 202.1371)$$

Table 5. Estimation PSTAR model of two-range

Variable	β_0	β_1
IS_{it}	-0.3586***	0.3861***
T-value	-2.9727	3.1809
Threshold value C	C_1	
	13.84%	
Slopes parameters	γ_1	
	202.1371	

*Notes:****, **, and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

The ranges are identified by the various regression slopes, β_0 and β_1. In the first range, where the insider shareholding is below 13.84%, the coefficient β_0 is -0.3586, significant at the 1% level, indicating that R&D spending reduces by 0.3586% with an increment of 1% in insider shareholding. In the second range, where the insider shareholding is larger than 13.84%, the coefficient $\beta_0+\beta_1$ is 0.0275, significant at the 1% level, showing that R&D spending increases by 0.0275% with an increment of 1% in insider shareholding. The estimates below 13.84% and larger than 13.84% are separately reducing and increasing R&D spending in the allocation of the insider shareholding threshold variable. Therefore, the two classes of companies demonstrated by the estimate points are those with ''low-IS '' (insider shareholding ≦13.84%) and "high-IS" (insider shareholding ＞13.84%). The high-IS range increases R&D spending 13.04 (0.0275,-0.3586) times more than does the low-IS range. The slope doesn't have a fixed value; in the low-IS range, the slope is -0.3586, while in the high-IS range, it is 0.0275, separately. Then, the results obviously illustrate that the relationship between R&D spending and insider shareholding (i.e. the slope value) varies with variance of insider shareholding structure, and there is an increasing trend. The transition function is plotted against R&D spending with each circle indicating an observation in Figure 1. There is a number of observations existed in-between and most of them located in either one of the extreme ranges. It's concluded that an effect insider shareholding larger than 13.84%, in which R&D spending is stridently increasing. These results are in abrupt contrast to those in the literature. Recall that Cho (1988) found that the relationship between insider shareholding and R&D spending is positive for shareholding less than 7% and above 38% and negative from 7% to 38%, respectively. The insider ownership, by contrast, are negative for shareholding levels below 13.84% and positive for levels above 13.84%, respectively, as well as vary in speed when they are in different ranges.



Insider Shareholding

Figure 1. Each circle shows an observation in the PSTAR model.

Table 6 shows the coefficient of the control variables. Cash flow is insignificantly associated to R&D spending in both ranges. Leverage is positively and significantly related to R&D investing in the ''low-IO'' regime, but negatively and significantly related to R&D investment in the ''high-IS'' range. Tobin's Q is significantly and negatively associated to R&D investment in both ranges. Size is significantly and negatively related to R&D spending in the ''low-IS'' range.

Table 6. Number [percentage] of companies in each year

Firm class	Year									
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Ave.
IS≦13.84%	46	49	68	73	79	84	80	81	87	88	73.5
	[18]	[19]	[27]	[29]	[31]	[33]	[32]	[32]	[35]	[35]	[29]
IS>13.84%	206	203	184	179	173	168	172	171	165	164	178.5
	[82]	[81]	[73]	[71]	[69]	[67]	[68]	[68]	[65]	[65]	[71]

The numbers in brackets show the percentage of firms in each range.

Table 7 illustrates the proportions of companies that were integrated in each of the two ranges every year. I found that the proportion in the ‘‘low-IS’’ class located between 18% and 35% of samples over the decade period. Around 29% of the companies belonged to the low-IS range. Companies in the high-IS range sorted between 65% and 82% of companies over the sample period, and 71% of the companies belonged to the high-IS range. Yeh and Woidtke (2005) found that ultimate controllers in Taiwan had authority to choose both supervisors and directors, and could reinforce their power by choosing trusted people or family members. Boards of directors and supervisors in Taiwan are controlled by ultimate controllers associated to family conglomerates holding a huge part of equity, and usually have an motivation to join outside stockholder interests by contributing to the company’s value (Villalonga and Amit, 2006; Maury, 2006). Advance study regarding whether diverse characteristics keep going in the two ranges of insider shareholding found that almost 34% (24%) of the high-IS (low-IS) range samples were composed 100% (100%) of a control-affiliated president, boards of directors and supervisors, and ultimate controllers. By comparing the high-IS range with the low-IS range, I found that the high-IS range (insiders with ultimate controllers) increased R&D investment 1.42-times (34%/24%) more than did the low-I range. These results indicated that insiders holding a large portion of equity were controlled by ultimate controllers associated to family conglomerates, who commonly had a motivation to make R&D spending decisions intended at maximizing the value of stockholders.

Table 7. Evaluation results of control variables

Variable	β_0	β_1
CF	-0.0162	0.0014
Leverage	0.0782***	-0.0935***
TQ	-0.0049***	-0.0074***
Size	-1.4645***	0.0106

*Notes:****, **, and * show significance at the 0.01, 0.05 and 0.1 levels, respectively.

5. Conclusions

This paper had examined whether insider shareholding affected R&D spending, employing a panel of 252 Taiwanese listed electronics companies during the decade (2002–2011) period. I found that a threshold effect exists between insider shareholding and R&D spending, which corresponds to an insider shareholding of 13.84%. When insider shareholding was less than 13.84%, R&D spending decreased by 0.05386% for each 1% increase in insider shareholding; When insider shareholding was more than 13.84%, R&D spending increased by 0.0275% for each 1% increase in insider shareholding. These results imply that at low range of insider shareholding, an increase in insider shareholding intensifies executive myopia and the under -investing problem regarding R&D investment. Conversely at high range of insider shareholding, executives become more likely to devote in risky R&D projects reflecting a closer alignment interests of stockholders and managers. The results also substantiate the view that nearly 34% of the high-insider shareholding range samples consisted of a 100% control-affiliated president, board of directors and supervisors, and ultimate controllers. Insiders holding a large portion of equity were dominated by ultimate controllers, who generally have an incentive to perform R&D efforts to generate new, sales-enhancing products to increase firm size, and in order, the position and reimbursement of executives.

References

Abdullah, F., Guo, W., & Mande, V. （2002）. The relation of managerial holdings with Tobin's Q and R&D expenditures: Evidence from Japanese firms. *Multinational Business Review*, 10, 66-71.

Bhattacharya, S., & Ritter, J. R. (1983). Innovation and communication: signaling with partial disclosure. *The Review of Economic Studies*, 50(2), 331-346. http://dx.doi.org/10.2307/2297419

Brush T.H., Bromiley, R., & Hendrickx, M. (2000).The free cash flow hypothesis for sales growth and firm performance. Strategic Mats which would increase the size of the firm, and in turn, the status and compensation of executives. *Management Journal* ,21,455-472. http://dx.doi.org/10.1002/(SICI)1097-0266(200004)21:4%3C455::AID-SMJ83%3E3.0.CO;2-P

Block, J. H., & Thams, A. (2008). Long-term orientation in family firms: A bayesian analysis of R&D spending. *SSRN eLibrary*. http://dx.doi.org/10.5465/AMBPP.2008.33650009

Chan, A. L. (2014). Innovation efficiency and asymmetric timeliness of earnings: Evidence from an emerging market. *International Review of Financial Analysis*, 32,132-142. http://dx.doi.org/10.1016/j.irfa.2014.01.014

Cho, Myeong-Hyeon. (1988). Ownership structure, investment, and the corporate value: empirical analysis. *Journal of Financial Economics*, 47,103-121. http://dx.doi.org/10.1016/S0304-405X(97)00039-1

Cosh, A., Fu, X. & Hughes, A. (2007). Management characteristics, managerial ownership and innovative efficiency in high-technology industry, SLPTMD Working Paper Series No. 007, Oxford.

Dickey, D. A,. & Fuller, W. A. (1979). Distribution of the estimators for autoregression time series with a unit root. *Journal of the American Statistical Association*, 74, 427–432. http://dx.doi.org/10.2307/2286348

Fama E. F., & Jensen, M.C. (1983). Separation of ownership and control. *Journal of Law Economics*, 26, 301– 325. http://dx.doi.org/10.1086/467037

Ghosh, A., Moon, & D., Tandon, K. (2007). CEO ownership and discretionary investments. *Journal of Business Finance & Accounting*, 34 (5-6), 819-839. http://dx.doi.org/10.1111/j.1468-5957.2007.02011.x

González, A., Teräsvirta, T., & Dijk, D.V. (2004). Panel smooth transition regression model and an application to investment under credit constraints, Stockholm School of Economics working papers.

González, A., Teräsvirta, T. & Dijk, D.V. (2005). Panel smooth transition regression model, Stockholm School of Economics, working papers.

Granger, C. W.J., & Teräsvirta, T. (1993). Modeling nonlinear economic relation-ships, *Oxford University Press*.

Guellec, D., & Van-Pottelsberghe de la Potterie, B. (2001). R&D and productivity growth: panel data analysis of 16 OECD Countries. *OECD Economic Studies*, 33,103–127. http://dx.doi.org/10.1787/eco_studies-v2001-art12-en

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: estimation, testing and inference.*Journal of Econometrics*, 93, 345-368. http://dx.doi.org/10.1016/S0304-4076(99)00025-1

Hull,R. M., Walker, R. & Kwak,S. (2013). IPO Valuation and Insider Manipulation of R&D. *Managerial Finance*, 39 (10). 888-914. http://dx.doi.org/10.1108/MF-05-2012-0125

Im, K. S., Pesaran, M. H. & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115, 53–74. http://dx.doi.org/10.1016/S0304-4076(03)00092-7

Jensen, M.C., & Meckling, W. H. (1976). Theory of the Firm: managerial behavior, agency cost and ownership structure. *Journal of Financial Economics*, 3, 305-360. http://dx.doi.org/10.1016/0304-405X(76)90026-X

Jensen, E.S., & Teräsvita, T. (1996). Testing parameter constancy and super exogeneity in econometric equations .*Oxford Bulletin of Economics and Statistics*, 58, 735-763. http://dx.doi.org/10.1111/j.1468-0084.1996.mp58004008.x

Kim, H., Kim, H., & Lee, P. M. (2008). Ownership structure and the relationship between financial slack and R&D investments: evidence from Korean firms. *Organization Science*, 19(3), 404-418. http://dx.doi.org/10.1287/orsc.1080.0360

Kor, Y. Y. (2006). Direct and interaction effects of top management team and board compositions on R&D investment strategy. *Strategic Management Journal*, 27(11), 1081-1099. http://dx.doi.org/10.1002/smj.554

Kroll, M.J., Wright, P., Toombs, L.A., & Leavell, H. (1997). Form of control: critical determinant of acquisition performance and CEO rewards. *Strategic Management Journal*, 18,85 – 96.

http://dx.doi.org/10.1002/(SICI)1097-0266(199702)18:2%3C85::AID-SMJ833%3E3.0.CO;2-H

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. (2002). Investor protection and corporate valuation. *Journal of Finance*, 57(3), 1147-1170. http://dx.doi.org/10.1111/1540-6261.00457

Laverty, K. J. (1996). Economic "short-termism": the debate, the unresolved issues, and the implications for management practice and research. *The Academy of Management Review*, 21(3), 825-860. http://dx.doi.org/10.2307/259003

Lee, P. M., & ONeill, H. M. (2003). Ownership structures and R&D investments of U.S. and Japanese firms: agency and stewardship perspectives. *The Academy of Management Journal*, 46(2), 212-225. http://dx.doi.org/10.2307/30040615

Levin, A., Lin, C. F. & Chu, C.-S. (2002). Unit root in panel data: asymptotic and finite-sample properties. *Journal of Econometrics*, 108, 1–24. http://dx.doi.org/10.1016/S0304-4076(01)00098-7

Luukkonnen, R., Saikkonen, P., & Teräsvirta, T. (1988). Testing linearity against smooth. *Biometrika*,75(3): 491-499. http://dx.doi.org/10.2307/2336599

Maury, B. (2006). Family ownership and firm performance: empirical evidence from Western European corporations. *Journal of Corporate Finance*, 12, 321-341. http://dx.doi.org/10.1016/j.jcorpfin.2005.02.002

Myers, S. C. (1984). The capital structure puzzle. *The Journal of Finance*,39(3),575- 592. http://dx.doi.org/10.2307/2327916

O' Connor, M., Rafferty, M., & Sheikh, A. (2013). Equity compensation and the sensitivity of research and development to financial market frictions. *Journal of Banking & Finance*,37, 2510-2519. http://dx.doi.org/10.1016/j.jbankfin.2013.02.005

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in a time series regressions. *Biometrika*, 75, 335–346. http://dx.doi.org/10.2307/2336182

Teräsvita, T. (1994). Specification, estimation, and evaluation of smooth transition autoregressive models. *Journal of the American Statistical Association*, 89, 208-218. http://dx.doi.org/10.2307/2291217

Tihanyi, L., Johnson, R. A., Hoskisson, R. E., & Hitt, M. A. (2003). Institutional ownership differences and international diversification: the effects of boards of directors and technological opportunity. *Academy of Management Journal*, 46(2), 195– 211. http://dx.doi.org/10.2307/30040614

Villalonga, B., & Amit, R. (2006). How do family ownership, control and management affect firm value?. *Journal of Financial Economics*, 80, 385-417. http://dx.doi.org/10.1016/j.jfineco.2004.12.005

Yeh, Y. H., & Woidtke, T. (2005). Commitment or entrenchment? : controlling shareholders and board composition. *Journal of Banking & Finance*, 29, 1857-1885. http://dx.doi.org/10.1016/j.jbankfin.2004.07.004

Yang, C.H., & Huang, C.H. (2005). R&D, size and firm growth in Taiwan‘s electronics industry. *Small Business Economics*, 25, 477–487. http://dx.doi.org/10.1007/s11187-004-6487-7