

**Elucidating Corporate Governance Using New View:
U-Shaped Relationship of Ownership Structure**

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Date: 2015.04.23

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Abstract

Does a simple, observable indicator exist that reveals whether a firm's corporate governance structure can be improved? To answer this question, a procedure for testing the U-shaped relationship of shareholding ratios and financial performance is established. From two hypotheses concerning the relationship between financial performance and ownership structure—the convergence-of-interest hypothesis (Jensen and Meckling, 1976; Jensen, 1993) and the entrenchment hypothesis (Jensen and Ruback, 1983; Jensen, 2005)—the extreme point of the nonlinear relationship clarifies sense about corporate governance. A lower extreme point of shareholding, the easier it is for the convergence-of-interest hypothesis is accepted.

To examine the influence of board composition on financial performance, the test for U-shaped relationship of Lind and Mehlum (2010) is utilized to find the optimal shareholding structures in Chinese and Taiwanese markets. The results are consistent with the hypothesis that corporate performance is a U-shaped function of the shareholding ratios. This study observes the sensitivity of the related variable about corporate governance, as education, board seats, leverage and firm size, affecting the movement of extreme value in U-shaped relationship. As the results show, the educational level of directors and supervisors, board size, firm size and leverage are negatively correlated with the quantity of the extreme points. Increasing the education level of directors can lower the extreme value of the shareholding ratio of the directors, the empirical shareholding ratio is more likely to be in a range in which the convergence-of-interest applies. The relevant hypothesis predicts that the interests between corporate insiders and the rest of the shareholders are thus converged, the effectiveness of corporate governance is improved.

Keywords: Corporate governance, financial performance, U-shaped relationship, shareholding ratio, extreme point.

JEL: G34 (Corporate Governance)

1. Introduction

When ownership is too dispersed and numerous shareholders cannot effectively monitor the operations of a company, the executive managers may hold only a minority stake and are very likely to take advantage of the company's assets out of self-interest. Establishing a mechanism for checking and balancing between shareholders and managers, to reconcile their interests and to prevent conflicts between them, is the main issue in corporate governance. The boards of directors, boards of supervisors and shareholders' meetings constitute the axis of internal corporate governance. The board of directors is the executive organ of the business; the supervisory board supervises the executive board; and the shareholders form the highest deliberative body the company. Accordingly, the key to corporate governance is preventing corporate insiders from using their positions to expropriate the interests of the shareholders for personal gain. Doing so involves preventing or controlling agency problems by establishing internal and external corporate governance mechanisms.

Previous investigations have tended to focus on the effects of corporate governance variables (such as equity structure, characteristics of the directors' boards, debt ratio and asset size, among others) on corporate performance, but they have tended to neglect consideration of whether corporate governance variables affect corporate governance itself. Therefore, this work proposes a new way to measure the level of corporate governance in a corporation using an easily observable and measurable corporate governance index, which is the extreme point of the shareholding ratio plotted against financial performance. The approach is expected to be able to answer simply the following questions. Can increasing the level of education of directors or supervisors improve corporate governance? Do corporate governance variables such as firm size, debt ratio, and board size (number of director/supervisor seats) reflect the effectiveness of corporate governance?

The theoretical basis for this approach lies in two hypotheses concerning the relationship between the shareholding ratio and financial performance. Jensen and Meckling (1976) proposed the "convergence of interest" hypothesis, which, based on agency theory, claims that when the top managers hold a high proportion of shares, they must bear most of the operational costs that are generated by agency-related problems, so their behavior is more rationalized, as they have a great incentive to

maximize the value of the firm; therefore, agency costs will be reduced. The other hypothesis is the “entrenchment hypothesis”, proposed by Jensen and Ruback (1983). The entrenchment hypothesis asserts that when corporate insiders hold at least a certain amount of shares, they will have enough voting power to maximize their personal utility and engage in anti-takeover behaviors out of consideration for personal status. The anti-takeover behaviors allow greater protection for managerial misconduct, and expense-preferring behaviors will become more pronounced; consequently, corporate performance naturally declines.

Morck *et al.* (1988) found that firm value is not linearly related to the degree of managerial ownership. Their empirical results reveal that when top-level managers have a shareholding ratio of between 5% and 25%, firm value and top level manager shareholding ratio present a negative correlation; when the shareholding ratio is over 25%, the shareholding ratio and the firm value are positively correlated with each other. The result supports both the convergence-of-interest and entrenchment hypotheses. Many later studies (Jensen, 1993; Chen, Ho, Lee and Shrestha, 2004; Jensen, 2005; Hung and Goo, 2006) utilized the non-linear model to elucidate or analyze the relationship between ownership structure and firm performance.

With respect to corporate governance, the turning points for the two shareholding ratios relationships discussed above, is the critical points that define differences in how top management and other shareholders react to the firm’s performance. When top managers react to firm performance by entrenching when their shareholding ratio is little, their strategies differ from those of the other shareholders, and agency problems immediately arise. As their shareholding ratio increases, the reaction of top managers toward firm performance becomes that of convergence-of-interest, and the strategies of top managers better match those of the other shareholders, and agency problems are thereby reduced. As corporate governance is improved, the convergence-of-interest effect is expected to become stronger relative to the entrenchment effect. This situation is reflected by the turning points of the shareholding ratios when the convergence-of-interest effect surpasses entrenchment effect. Therefore, the quantifiable turning points of shareholding ratios are the observable index of the effectiveness of corporate governance.

This study collects data from the Taiwan Stock Exchange, the Shanghai Stock Exchange, and the Shenzhen Stock Exchange from 2006 to 2012, including on the

corporate governance variables and financial performance of listed companies, to observe and analyze ownership structures empirically. China and Taiwan implemented corporate governance regulations at roughly the same time. This investigation reveals that, for the companies listed in China, the reactions of directors and supervisors to firm performance exhibit the “convergence-of-interest” effect, meaning that the interests of the directors and supervisors are consistent with those of the companies. However, in Taiwan, the average shareholding ratio of board directors and supervisors (21.58%) is lower than the turning point in the U-shaped relationship between shareholding ratio and financial performance (31.71%). Accordingly, the shareholding ratios of the directors and supervisors are too low in Taiwan and exhibit the “entrenchment” effect. Within the range of this effect, when a firm’s financial performance is poor, directors and supervisors react by increasing their shareholding ratios. Conversely, when the firm’s financial performance is good, directors and supervisors react by selling off shares to line their own pockets. To demonstrate the existence of the turning points, the appropriate test of the U-shaped relationship that was developed by Lind and Mehlum (2010) is utilized herein. We also find some factors that affect the amount of turning points, and to determine the range of appropriate equity ownership structures for the board of directors.

This study comprises six sections, including this introductory section. The second section discusses relevant literature and theories concerning the non-linear relationship between equity structure and financial performance, based on which the tested hypothesis is established. The third section presents the study design and model used. The fourth section examines OR considers the listed companies in China and Taiwan to observe empirically the turning points of equity structure ratios, and to test whether U-shaped relationships exist. The fifth section analyzes the factors that affect the amount of turning points: a sensitivity analysis of important corporate governance variables is performed to observe whether the corporate governance system changes for better or for worse. Finally, the sixth section draws conclusions.

2. Literature Review

The meaning of corporate governance can be elucidated from the perspectives of law and finance. Legally, corporate governance concerns the separation of ownership and control in the modern corporate structure, including the balance and control of

corporate governance through legalization, the supervision of the activities of the corporation as an organization, and the ensuring of good and healthy business practices, to prevent illegal activity. Financially, corporate governance is a system that maximizes the financial value of a firm, such as by maximizing the return for shareholders, creditors, and employees, addressing the issue of how investors can ensure that managers are using funds optimally and that they will receive a proper return on their investment. Many studies have pointed out a significant positive correlation between corporate governance and financial performance, firm value and stock price.

This study concerns the financial aspect of corporate governance: “corporate governance” is treated as a means of guiding management to ensure that top managers meet their responsibility to improve increase firm performance, in order to protect shareholders’ rights, taking into accounts their own interests. From this perspective, the core issue in corporate governance concerns the board of directors, and the effectiveness of corporate governance is strongly related to the ownership structure. The ownership structure and board characteristics are critically importance to the mechanisms of corporate governance. Therefore, this study seeks to elucidate the influences of ownership structure and board characteristics, as corporate governance variables, on firm performance. Zahra and Pearce (1989) suggested an integrative model of board attributes and roles, including board type and board structure. Among board attributes, this study emphasizes the director/supervisor shareholding ratio, the level of education of the directors/supervisors, and the board structure.

2.1. Ownership Structure

As a company expands, influenced by internationalization and institutionalization, it will gradually become an organization that is characterized by “separation of management and ownership”; but such an organization faces agency problems. Generally, the ownership structure provides the basis for corporate governance. Different ownership structures correspond to distinctively different ways in which the shareholders exercise power, affecting the operation and performance of the firm. Therefore, ownership structure is one of the major factors that affect corporate governance.

The two major hypotheses concerning the relationship between managerial

shareholding ratio and firm performance are the “convergence-of-interest hypothesis”, proposed by Jensen and Meckling (1976), and “entrenchment hypothesis”, proposed by Jensen and Ruback (1983). These two hypotheses describe the potential non-linear relationship between the insider shareholding ratio and firm performance.

Morck *et al.* (1988) carried out piecewise regression analysis to determine that the relationship between firm value and the shareholding ratio of top managers is non-linear for American listed companies. Empirical analysis reveals that when the manager shareholding ratio is between 0% and 5%, the ownership structure is positively correlated with firm value, but when the ratio is between 5% and 25%, the correlation is negative. When shareholding ratio exceeds 25%, the correlation is positive again. This finding demonstrates the existence of both convergence-of-interest and entrenchment effects.

McConnell and Servaes (1990) analyzed 1173 firms in 1976 and 1093 firms in 1986 in a study of Tobin’s Q and equity structure. They found that Tobin’s Q and the equity structure exhibit a mutual non-linear relationship and that this non-linear relationship is independent of time and environment. Davies *et al.* (2005) extended that study and proved the existence of non-linear relationship of high degree between equity structure and financial performance. Several follow-up studies (Chen *et al.*, 2004; Hung and Goo, 2006) utilized the non-linear model to analyze the relationship between equity structure and firm performance.

Other studies, while supporting the non-linear relationship, have yielded different results. Dickins and Houmes (2009) suggested that when the market is stable or growing, the internal shareholding ratio is significantly positively correlated with a firm’s financial performance; but when the market is declining, it is not. Weiss and Hilger (2012) analyzed listed companies in eight developed countries, and while their results support the non-linear relationship, their evidence does not do so to a significant degree.

Some studies focus on the shareholding ratio of institutional investors. Institutional investors are more professional and have greater access to information than others, so their monitoring costs are lower. The shareholding ratios of institutional investors are increasing, according to data that are published by the stock exchanges, indicating that corporate stocks are moving from individual investors to institutional investors. Therefore the influences of institutional investors on

corporations should not be overlooked. Pound (1988) proposed the efficient monitoring hypothesis, which claims that since institutional investors can more efficiently monitor corporate managers, increasing institutional shareholding can efficiently reduce the agency problem and improve firm performance. McConnell and Servaes (1990) examined American corporations, discussed the relationship between control of agency problems and firm performance, and found that the institutional shareholding ratio is significantly positively correlated with Tobin's Q. Bhojraj and Sengupta (2003) suggested that a higher institutional shareholding ratio leads to more effective corporate governance and, therefore, less of a conflict of interest between funders and managers, along with a better credit rating.

Based on these findings, this study defines the first hypothesis for examining as follows.

H_{01} : The shareholding ratio of directors/supervisors is non-linearly related to the financial performance of the firm.

2.2. Education Level of Board Directors/Supervisors

Intellectual capital is now regarded as an important resource in business management; therefore, corporations frequently hire managers and board members with special or professional knowledge. Bantel (1993) suggested that diverse educational backgrounds and special functions of a board of directors help firms make better important decisions. Gottesman and Morey (2006) suggested that the level of education of top managers is an important proxy variable for intellectual capital. Mahadeo *et al.*(2012) analyzed emerging markets and found a significant positive correlation between the diversity of educational backgrounds of the board and firm performance. Darmadi (2013) introduced other controlling variables (such as firm size and family control of the enterprise to examine further the relationship between level of education of the board and financial performance. The study demonstrated that graduate-level education of the top management team (directors and executive officers) has a significant positive effect on firm performance.

Based on the above findings, the second hypothesis for testing is defined as follows.

H_{02} : The level of education of the board of directors/supervisors is associated with the financial performance of the firm.

2.3. Board Structure

Yermack (1996) found an inverse relationship between board size and firm value; a larger board is not as efficient as a smaller board. However, Zahra and Pearce (1989) suggested that board size affects OR influences the functional effectiveness of the board of directors; a larger board allows directors to perform their duties and monitor the firm, improving firm performance. Goilden and Zajac (2001) conducted an empirical analysis to suggest that board size and firm performance exhibit an inverse U-shaped correlation: the a correlation is positive before when the board is smaller than its optimal size, and a negative in the other situation. Cristina (2013) suggested that board structure (including size and composition) affects the financial performance of the firm but, conversely, the financial performance and type of firm also influence the board structure.

Based on these findings, the arguments suggest the following hypothesis.

H_{03} : The scale of the board is associated with the financial performance of the firm.

3. Study Design

This study concerns the non-linear relationship between the structure of ownership by company insiders and the financial performance of their company. This proposed model is utilized to determine whether an extreme point exists in the possible U-shape relationship, and whether other related corporate governance variables influence the extreme value of this relationship.

The proxies that are generally used in financial performance can be classified into market-based measures and accounting-based measures. A market-based proxies of financial performance is based on the market returns of investors; common market-based indices are Tobin's Q, MVA (market value added), and M/B (market-to-book ratio). On the other hand, common accounting-based measures to the firm's actual financial earnings are EPS (earnings per share), ROA (return on assets), and gross profit rate.

In the field of corporate governance, many factors influencing a firm's financial performance have been discussed. Equity structure and board characteristics are commonly confirmed to be associated with financial performance (as shown in Table 1). Numerous studies have introduced into their models controlling variables that do

not belong to the categories of equity structure and board characteristics, but significantly associated with firms' financial performance. McConnell and Servaes (1990), Griffith *et al.* (2002), and Hung and Goo (2006) have suggested that firm size is significantly related to its market value. Morck *et al.* (1988) Dwivedi and Jain (2005) share the view that increasing the debt ratio of corporations can strengthen external monitoring, reducing the company's agency problem and increasing the effectiveness of the internal corporate governance system.

<Table 1 is suggested to be attached here.>

Based on the literature that was reviewed in the previous section and the proposed hypotheses, this study empirically analyzes the impacts of equity structure, other board characteristics on firm's financial performance using the following model.

$$\begin{aligned}
 \text{Tobin's } Q(\text{or MVA, ROA})_t = & \beta_0 + \beta_1 \times \text{Shareholding}_t + \beta_2 \times \text{Shareholding}_t^2 \\
 & + \beta_3 \times \text{Education}_t + \beta_4 \times \text{Board seats}_t \\
 & + \beta_5 \times \log(\text{Firm Sizes})_t + \beta_6 \times \text{Leverage}_t + \varepsilon_t \quad (1)
 \end{aligned}$$

The observed variables in the model are as follows.

shareholding:	proportion of shares held by board directors/supervisors
education:	average level of education of board directors/supervisors
board seats:	number of directors/supervisors

The control variables are as follows.

firm size:	total assets of firm
leverage:	debt to equity ratio
ε	error term
t :	year t

The financial performances of enterprises are measured with Tobin's Q, MVA, and ROA as proxy variables. Generally, larger firms can put more resources into corporate governance, and such firms should exhibit greater corporate social responsibility, resulting in better self-regulation. Since the breadth of the firm scale is also too great, the natural logarithms of the absolute values are utilized in our models.

The advanced observation is based on the aforementioned non-linear relationship (between firms' financial performance and the shareholding ratio of directs), and concerns the existence of extreme point of financial performance in this

non-linear relationship, which is tested using the methodology developed by Lind and Mehlum (2010) in our follow-up analysis. This advanced methodology tests whether the extreme point of financial performance exists within rational range of shareholding ratio.

Since the extreme point of the non-linear relationship represents the turning point of the “convergence-of-interest hypothesis” and “entrenchment hypothesis”. When the proportion of shares held by board directors/supervisors is less than the extreme point, the “entrenchment hypothesis” applies appropriately in the protection of the authority of boards. The worse the firm performance is, the more the proportion of shares held by board directors/supervisors will be increased. Then the probability of successful anti-takeover behavior by insiders will be vastly increased, the managerial malfeasance further leads to the reduction of firm performance.

Conversely, when the proportion of shares held by board directors/supervisors is beyond the extreme point, the “convergence-of-interest” hypothesis facilitates further. The better the firm performance is, the more the proportion of shares held by board directors/supervisors will be increased. These top managers have more motivation to maximize the firm’s value; the interests of the managers converge with those of the company, and reducing agency costs.

To help to realize the impacts of the variables related to corporate governance on the extreme points, the following four situations will be observed concerning this extreme point.

- (1) Whether will be the proportion of shares held by board directors/supervisors in extreme point changed when the education level of the directors is raised?
- (2) Whether will be the proportion of shares held by board directors/supervisors in extreme point changed when the director seats are increased?
- (3) Whether will be the proportion of shares held by board directors/supervisors in extreme point changed when the firm has more assets?
- (4) Whether will be the proportion of shares held by board directors/supervisors in extreme point changed when the debt/equity ratio of the firm is higher?

Generally, the higher level in education of directors, the more board seats, total assets and leverage of enterprises lead to improve the quality of corporate governance. In this study, we would like to observe whether the effectiveness of corporate governance reduce the shareholding ratio of the extreme point. At once the critical

point for the convergence of insiders and company interests moves lower, the real insiders' shareholding ratio is more easily able to exceed the critical point. The probability of incurring agency costs will be reduced, so the corporate governance is more implemented.

4. Results: Estimation and Testing of the U-shape relationship

In this investigation, the collected data concern companies listed on the Shanghai Stock Exchange and the Shenzhen Stock Exchange in China and the Taiwan Stock Exchange in Taiwan. The number of listed companies and the trading volumes make these three stock exchanges representative of Sinitic stock exchanges. The data are taken from 2006 to 2012. Elimination of companies with incomplete data leaves 8872 samples. The data include financial statements, prospectuses, and declarations of the board of directors/supervisors. The main source of data comes from the Taiwan Economics Journal Database. Sorted annual data are utilized for panel data analysis. Panel data analysis combines cross-section and time series samples to identify variations in the characteristics of samples and their changes over time. Hsiao (2003, 2005) suggested that panel data analysis can reduce the co-linearity problems between the variables and may have high degrees of freedom in estimation.

The proxy variables of performance in this investigation are Tobin's Q, MVA and ROA. These factors are all important financial indices of a firm. In China, the mean Tobin's Q is 2.84; the standard deviation is 5.99, and the range is between 0.58 and 235.61 as shown in table 2. With respect to board director/supervisor shareholding, in China, the mean shareholding ratio of this group is 59.32%; its standard deviation is 16.76%, and the range is between 7.60% and 97.67%. The average education level of the directors/supervisors of listed companies is 3.30 (where the education level index is 5 for a doctorate, 4 for a master's, 3 for a bachelor's, 2 for high school, and 1 for less than below high school). The mean number of board seats is 17.31. The mean total assets are US\$ 971.53 million. The mean leverage (total debts/net value) is 54.16%. On the other hand, Taiwan's Tobin's Q is lower, with a mean of 1.28, revealing that listed companies in Taiwan have a lower P/E ratio and a lower MVA than the listed ones in China. The mean shareholding ratio of directors/supervisors (21.58%) is lower than that in China (59.32%); the mean number of board of director/supervisor seats (7.35) is also lower than that in China (17.31). Table 2

presents other relevant properties.

<Table 2 is suggested to be attached here.>

Pearson's correlation coefficient was utilized to test the five explanatory variables - director/supervisor shareholding ratio, director/supervisor education level, number of director/supervisor seats, total assets and leverage. The correlation coefficient matrix in Table 2 presents the results of the test. Although the table reveals some correlations between education level and shareholding ratio, leverage and shareholding ratio, education level and number of seats on the board, education level and total assets, and between number of seats on the board and total assets, the absolute values of the correlation coefficients are only between 0.01 and 0.38, so the correlations are weak. Accordingly, the five explanatory variables do not exhibit high collinearity.

Using Eq. (1) and the proxy variables for performance in this study (Tobin's Q, MVA, ROA), this study establishes Model 1, Model 2, and Model 3 (As shown in Table 3). Since some of the sample data are flawed, the number of samples from China was 5881 and that from Taiwan was 2991. For China, Model 1 (Tobin's Q), has the best explanatory power, with Adj-R-squared=0.328672 (with an F-value of 479.8947). The estimated coefficients of all explanatory variables are all significant, meaning that the six explanatory variables are important corporate governance variables that effectively influence the market value of the firm. The linear coefficient of the director/supervisor shareholding ratio is negative, whereas the quadratic term in the director/supervisor shareholding ratio is positive, so the model reveals that the shareholding ratio is non-linearly related to firm performance (as shown in Fig. 1). Eq. (1) is transformed into Eq. (2) to yield extreme points. The shareholding ratio at the extreme point of the nonlinear relationship given by Model 1 is 44.75%. (For Model 2, the extreme point is at a shareholding ratio of 41.65%).

$$\frac{\partial(\text{Performance})_{it}}{\partial(\text{Shareholding})_{it}} = -\beta_{1i} + 2 \times \beta_{2i} \times \text{Shareholding}_{it} + G'(X_{3t}, X_{4t}, X_{5t}, X_{6t}) \quad (2)$$

$$\text{Extremum: } \text{Shareholding}^* = \frac{\hat{\beta}_1}{2\hat{\beta}_2}$$

where $\hat{\beta}_1$ is the estimate of β_{1i} , and $\hat{\beta}_2$ is the estimate of β_{2i}

If the shareholding ratio of all insiders is less than 44.75%, then the company insiders, to maximize their own utilities, may more engage in anti-takeover behaviors to solidify their own positions, increasing insider shareholding when the market value

decreases and selling shares when the market value rises. Such self-interested behaviors are what corporate governance seeks to prevent or control. Conversely, in China, the most of company insiders' shareholding ratio exceeds 44.75% (as shown in Fig. 1), then the part of agency cost will be absorbed by the company insiders. The interests of the top managers will converge with those of the company, so the activities of the top managers will be more rational, they have more motivation to maximize firm value. The shareholding of boards will increase with the market value of the firm, so the goal of corporate governance has been achieved further.

<Fig. 1 is suggested to be attached here.>

We suggest that the extreme points can be utilized as a concrete index to observe whether corporate governance of some firms is implemented in rational region. As the Chinese cases shown, we can judge that the interests of the top managers converge with those of the company in the view of shareholding ratio. From Table 3, Model 2&3 has less explanatory power than the Tobin's Q model. The actualization of corporate governance system also affects market value of a firm, but to a lesser degree that it affects the profitability. Also, increasing the number of seats on the board or the shareholding ratio does not necessarily increase the profitability of the enterprise (As shown in Model 3 of Table 3).

<Table 3 is suggested to be attached here.>

For Taiwan, Model 1 (which explains Tobin's Q variable) has the most explanatory power. The utility of the model is significant and the F-value is 34.99852. The estimated coefficients of all of the explanatory variables except the number of board seats and leverage, are all significant, meaning that the linear director/supervisor shareholding ratio term, the quadratic term in the director/supervisor shareholding ratio, the mean level of education of the board members, and total assets all influence the financial performance of the enterprise. For Taiwan, the calculated extreme point of the shareholding ratio according to Model 1 is 31.71%. The linear director/supervisor shareholding ratio term is negative, while the quadratic term in the director/supervisor shareholding ratio is positive, revealing the existence of non-linear relationship. (as shown in Fig. 1(b)).

While the extremum of the non-linear relationship, given in Table 3, may theoretically exist, remains to be tested whether it exists within the rational shareholding range. To conduct a more stringent test for the U-shape relationship

between shareholding ratio and firm performance, this study follows the method suggested by Lind and Mehlum (2010) and test for the following conditions.

- (1) The slopes of the relationship must be found that both significantly positive slopes and negative ones exist within the specific interval $[Shareholding_{min}, Shareholding_{max}]$.
- (2) The slopes of the relationship must be found that both significantly positive and significantly negative ones exist within the confidence interval, $[Shareholding_{95\%lower}^*, Shareholding_{95\%upper}^*]$, of the extremum.

An U-shaped relationship requires the slope of the curve to be positive at the start and negative at the end of a reasonably chosen interval of shareholding ratio. In this study, we use the observed data range as the chosen interval. The rejection area (criteria) is shown in Eq. (3). Let σ_{11} is the estimated variance of $\hat{\beta}_1$; σ_{22} is the estimated variance of $\hat{\beta}_2$; σ_{12} is the estimated covariance of $\hat{\beta}_1$ and $\hat{\beta}_2$, and the null hypothesis concerning the actual existence of the extremum is as follows.

$$H_{04}: \beta_1 + 2 \times \beta_2 \times Shareholding_{min} \geq 0$$

$$H_{05}: \beta_1 + 2 \times \beta_2 \times Shareholding_{max} \leq 0$$

$$H_{06}: \beta_1 + 2 \times \beta_2 \times Shareholding_{95\%lower}^* \geq 0$$

$$H_{07}: \beta_1 + 2 \times \beta_2 \times Shareholding_{95\%upper}^* \leq 0$$

The corresponding t-statistic is :

$$t_i = \frac{\hat{\beta}_1 + 2 \times \hat{\beta}_2 \times (Shareholding)_i}{\sqrt{\sigma_{11} + 2 \times \sigma_{12} \times (Shareholding)_i + \sigma_{22} \times (Shareholding)_i^2}}, \quad (3)$$

where $i = \text{min, max, 95\% lower bound and 95\% upper bound}$

According to Fig. 1(a), for China, the four hypotheses (H_{04} , H_{05} , H_{06} , and H_{07}) are significantly rejected, that is, those companies owe U-shaped relationship between the board shareholding ratio and Tobin's Q. The slope at the lower bound on the 95% confidence interval of the extreme point (17.21%) and the minimum shareholding ratio (7.60%) are significantly negative according to the T-test. The slope at the upper bound of the 95% confidence interval (72.28%) and the maximum shareholding ratio (97.67%) are significantly positive. Hence, the relationship is confirmed to have a statistically significant U-shaped relationship in China.

Figure 1(b) plots the non-linear relationship between Tobin's Q and the board

shareholding ratio for Taiwan companies. The four hypotheses (H_{04} , H_{05} , H_{06} , and H_{07}) are significantly rejected. The slope at the lower bound of the 95% confidence interval and the minimum shareholding ratio are significantly negative (with t-values of -2.66 and -3.37, respectively). The slope at the upper bound of the 95% confidence interval and the maximum shareholding ratio (98.07%) are significantly positive (with t-values of 6.37 and 15.14, respectively). This result also reveals that the non-linear relationship of the shareholding ratio in Taiwan is significantly U-shaped.

A comparison between China and Taiwan companies indicates that the mean board shareholding ratio (59.32%) of enterprises exceeds the one in Taiwan (21.58%). The reactions of board directors in China reach toward the convergence-of-interest hypothesis. Restated, the directors increase their shareholding as their firm's performance improves, so the interests of the directors are aligned with those of the firm. However, the mean total shareholding ratio (21.58%) of the board of directors/supervisors in Taiwan is below the extremum (31.71%) in Taiwan, revealing that the overall shareholding ratio of directors in Taiwan is too low, and the behaviors of directors could approach the expectation of entrenchment hypothesis concerning corporate governance. Within the range of shareholding ratios in which this hypothesis applies, when firm performance is poor, board directors/supervisors respond by increasing their shareholding ratio to manipulate the stock price or to prevent takeover attempts from the market. Conversely, when firm performance improves, the directors respond by selling their shares for their own financial benefit. Such short-term investment behavior does not favor corporate governance

5. Discussion and Implications: Sensitivity Analysis in the Extreme Point

The second purpose of this study is to use quantitative statistics to analyze the sensitivity of extreme point in the U-shape curve between firm performance and shareholding ratio of the board of directors by the aforementioned models. Since the extremum of U-shape curve represents the turning point of the convergence-of-interest hypothesis and the entrenchment hypothesis, the variation of shareholding ratio in the extremum can be treated as the observation of implement in corporate government. Once the extreme value drops lower, the critical point in the convergence of the interests of the corporate insiders with those of the corporation will move lower, so the internal shareholding ratio is more likely to exceed the critical

point. Due to the easier convergence of interest, the company has more effective corporate governance. Conversely, if the extreme one will raise higher, the behaviors from the entrenchment effects are more in vogue, then the agency problem results in greater managerial protection. Due to more agency cost in entrenchment effects, the company will turn into the worse situation of corporate governance.

In this section we want to answer the following question. Does a higher level of education of the directors lead to lower the extreme value of U-shape curve? If the phenomenon is confirmed, this means that the higher level of education of directors leads to corporate governance more putting into effects. Simultaneously, some similar questions are observed. Does increasing the number of seats on the board of directors lower the extremum in shareholding ratio? Does more firm leverage lower the extreme one? Or do greater firm assets result into dropping the minimum in U-shape relationship? If the situations are observed significantly, the related variables are treated as the sensors in the implement of corporate governance.

Since only the models of Tobin's Q exhibit a significant non-linear relationship for both China and Taiwan (Table 3), these models are used to determine whether the minimum in the two areas vary with education level, number of seats on the board, firm leverage and firm assets as discussed below. The results reveal that the regression coefficient of the shareholding ratio and the corporate governance-related variables are all significant?

<Table 4 is suggested to be attached here.>

To determine the impacts of the level of education of directors in China on the extremum of the firm performance, the 5881 samples are divided into five groups based on the mean level of education of the directors. Estimation based on Eq. (2) and testing with Eq. (3) shows that the fifth group does not have a significant extreme point for the U-shape relationship. As displayed in Table 4, except for the fifth group, as the education level increases, the extreme point moves slightly downward, indicating that the firm can more easily enter the ideal range of corporate governance. For example, the mean education level of the first group of directors is 2.71 in China (2 is below undergraduate; 3 is a bachelor's; 4 is a master's; 5 is a doctorate). The shareholding ratio in the extreme point is 48.72%, meaning that when the shareholding ratio of company insiders exceeds 48.72%, the enterprise is in the range where the convergence-of-interest effect applies. The mean education level of the

fourth group is 3.52; and the group's extreme point for the shareholding ratio is 39.68%, so when the shareholding ratio of company insiders in this group exceeds 39.68%, the corporation is in the range in which the convergence-of-interest effect pertains. According to Table 4, when the average education level of the directors is increased by one point (from high school to bachelor's degree, or from bachelor's degree to master's degree, for example), the extremum for the shareholding ratio is lowered by 62.08%. Since the firms in the fifth group with directors with a high education level tend to be high tech-firms, and such firms tend to have a higher net profit or net loss than other firms, the explanatory coefficients in model are insignificantly estimated.

Similarly, in China, the number of seats on the board, leverage and firm size effectively lower the shareholding ratio in extreme points. Table 4 indicates that firm size has the most significant effect on the improvement of corporate governance. The sensitivity of the optimal point to education level is -62.08, while that to firm size is -169.49%. Hence, if the companies would like to improve the effectiveness of corporate governance with the view of interest convergence, the best practice is raising their scale of operation, the second is enhancing educational level of directors.

<Fig. 2 is suggested to be attached here.>

This result shows at the same table that whereas the effectiveness of corporate governance increases with the mean education level of the directors of companies in Taiwan, it does not so as much as in China (as shown in Fig. 2 (a) and 2(b)). It would be inferred that Taiwan has a fully developed higher education system for a long time, and most corporate managers already have high degree in education. Hence, high education level does not significantly lower the extreme point of U-shape curve in Taiwan.

The Tobin's Q model can be also used to observe the changes in the extreme point of U-shape curve in China and Taiwan, grouped by leverage. As displayed in China, a higher leverage results in a lower extreme point. However, if the firm's leverage increases further, its financial risk also greatly increases. From Table 4, further increasing leverage increases the extreme value due to huge financial risks. (The total debt/total assets of the fifth group is 89.97%.) Leverage initially exhibits a positive effect on the extremum, then exhibits a negative. The situation can be concluded that when the leverage is low, increasing leverage can introduce an external

monitoring mechanism and thereby improve corporate governance. When the firm's leverage is high, agency problems arise between external funders and internal managers. Therefore, increasing leverage raises and then lowers the extreme value of the shareholding ratio . (See Table 4 for China.)

6. Conclusion

Previous studies have demonstrated that the shareholding ratios of directors/supervisors, blockholders, professional managers and corporate insiders exhibit non-linear relationships with the firm's financial performance (McConnel and Servaes, 1990; Griffith *et al.*, 2002; Chen *et al.*, 2004; Hung and Goo, 2006). Morck *et al.* (1988) utilized piecewise regression to reveal inflection points in the relationship. This study refers initially to the extreme point in the non-linear relationship to discuss the asymmetry of strategy selection by internal funders (shareholders) and corporate insiders (board directors/supervisors, blockholders, and top managers), based on agency theory, the "convergence-of-interest hypothesis" (Jensen and Meckling, 1976; Jensen 1993) and the "entrenchment hypothesis" (Jensen and Ruback, 1983; Jensen, 2005).

The extremum of the non-linear relationship is treated as critical point at which a reduction of agency problems can be observed. Below the extreme point of the shareholding ratio, the entrenchment hypothesis applies so poorer firm performance causes the directors/supervisors to have a higher shareholding ratio, and as firm performance improves, the directors/supervisors respond by selling their shares to increase their personal investment returns. This investigation finds evidence of this phenomenon in the companies listed in Taiwan, because the mean board shareholding ratio is 21.58%, which is much lower than the 31.71% at the extreme point, indicating that directors of listed companies in Taiwan tend to engage in short-term investment behavior and sell shares as the stock price rises. This phenomenon greatly improves the success of the anti-takeover behavior of corporate insiders, as directors/supervisors with minority shares can obtain control of the firm, leading to greater cover for managerial malfeasance and a decline in firm performance, in tension with the principles of corporate governance.

If the shareholding ratio of the board of directors/supervisors is above the extreme point that is estimated herein, then the convergence-of-interest effect applies,

and top managers have an relatively high motivation to maximize firm value. As the interests of managers and the firm converge, the probability of incurring agency costs is reduced. The extreme point of this U-shape relationship between the shareholding ratio of the directors and firm performance can be significantly lowered by considering some corporate governance variables ,such as the education level of the directors/supervisors, the number of seats on the board, external financing, and firm size. When the critical point for the convergence of managerial and firm interests is lowered in this way, the shareholding ratio of the corporate insiders is more able to exceed the critical point, reducing agency problems, and improving corporate governance.

This study adopts the test of U-shaped relationship in Lind and Mehlum (2012) to develop a quantitative method for estimating the shareholding ratio in the extreme point. The non-linear relationship is tested significantly as U-shaped curve, and , for the listed companies in the studied regions between 2006 and 2012, the firm performance reacts in a bipolar positive and negative manner to the shareholdings of the board of directors. When the shareholding ratio is low, it negatively influences firm performance; when it is high, it positively affects firm performance. The empirical findings in this study show that the means of the shareholding ratios of directors/supervisors of companies listed in China (59.32%) are above the extreme value of the shareholding ratio that is estimated in this study (44/75%). This phenomenon is consistent with the principles of good corporate governance: as firm performance improves, board directors and blockholders increase their shareholding ratios, so the board and firm exhibit convergent interests.

With respect to factors that influence the extremum in the non-linear relationship, this study empirically demonstrates that the average education level of directors/supervisors, the number of seats on the board of directors/supervisors, the leverage (which is proxy variable for external financing ratio), and firm assets all importantly influence the extreme point. Increasing the education level of directors can lower the extreme value of the shareholding ratio of the directors (as was confirmed by empirical analyses in China). If the turning point of the shareholding ratio can be significantly lowered due to raising the education level, then the empirical shareholding ratio is more likely to be in a range in which the convergence-of-interest applies. The relevant hypothesis predicts that agency problems between corporate

insiders and the rest of the shareholders are thus reduced, the effectiveness of corporate governance is improved.

Similarly, increasing the number of seats on the board, leverage, or firm size is demonstrated to lower the extreme value of the shareholding ratio of the directors/supervisors, so the empirical shareholding ratio is more likely to be in a range in which the convergence-of-interest applies. With respect to leverage, when the leverage is low, increasing leverage can introduce an external monitoring mechanism to the firm, improving its corporate governance. However, when the firm's leverage is increased to a beyond a threshold, financial risks may increase greatly, so leverage initially lowers and then raises the extreme value of the shareholding ratio.

Table 1. Literature on Effects of Ownership Structure and Board Characteristics on Financial Performance

Research Area	Financial Performance Index	Important Influential Variables	Controlled Variables	Author	Result/Influence
Ownership Structure	Tobin's Q, profit rate	Board's stakeholding rate	R&D/assets, Advertising/assets, Debt/assets, Replacement cost/assets	Morck, Shleifer and Vishny (1988)	significant nonlinear relationship
	Tobin's Q	% of shares held by insiders, % of shares held by blockholders, % of shares held by institutions	Debt/replacement value, R&D/replacement value, ADV/replacement value	McConnell and Servaes (1990)	significant nonlinear relationship
	Tobin's Q, EVA, MVA	CEO ownership (%), Inside Ownership (%)	Total Assets, Debt ratio	Griffith, Fogelberg and Weeks (2002)	significant nonlinear relationship
	Tobin's Q	% of top5 shareholders	R&D/sales, Debt ratios, Fixed Cost/Sales	Welch (2003)	+(positive)
	Tobin's Q, Economics Value/sales	% of shares held by insiders, % of shares held by blockholders	R&D/sales, Debt ratios, ADV/sales, Free Cash Flow/sales	Chen, Ho, Lee and Shrestha (2004)	significant nonlinear relationship
	Tobin's Q	CEO ownership (%), Inside Ownership (%)	Leverage, Assets size	Davies, Hillier and McColgan (2005)	+(positive)
	Tobin's Q	% of shares held by foreign investors, % of shares held by public investors, % of shares held by institutions	R&D/sales, Debt ratios, ADV/sales, ROCE	Dwivedi and Jain (2005)	+(positive)
	Tobin's Q	Board's stakeholding rate	Total Assets	Hung and Goo (2006)	significant nonlinear relationship
	Tobin's Q, ROA, ROE	CEO ownership (%), % of top25% owners	Total Assets, Leverage	Dickins and Houmes (2009)	+ in normal market
	Market Price per Share, EPS	% of dominant shareholder, % of shares held by insiders, % of shares held by foreigners	-----	Tsegbra and Wilson (2011)	no significant effect
	Tobin's Q	Board's stakeholding rate	Leverage, Market Capitalization	Weiss and Hilger (2012)	insignificant nonlinear relationship

Table 1. (continued)

Board Education Level	ROA	Educational Background	-----	Mahadeo, Soobaroyen and Hanuman (2012)	+(positive)
	Tobin's Q, ROA	Educational Background	Total Assets	Darmadi (2013)	+ in prestigious universities
Board Size	MB, ROA	board size	Leverage	Andre, Azofra and Lopez (2005)	-(negative)
	Tobin's Q	board size	R&D/sales, Debt-equity ratios, Advertising intensity, ROCE	Dwivedi and Jain (2005)	no significant effect
	financial Performance	board size	-----	Cristina (2013)	+(positive)

Data Source: Compiled by this study.

Table 2(a). Analysis of Descriptive Statistics in China

Descriptive Statistics	Research Variables	Mean	Median	St. Dev.	Min	Max
China Number of Samples: 5881	Tobin's Q	2.84	2.02	5.99	0.58	235.61
	Market Value Added (US\$ M)	637.92	291.18	1407.15	-3304.66	26652.84
	ROA (%)	5.59	4.99	30.49	-261.47	293.3
	Shareholding (%)	59.32	61.16	16.79	7.6	97.67
	Education(1~5)	3.3	3.33	0.39	2	4.39
	Board Seats	17.31	16	5.16	6	62
	Total Assets(US\$ M)	971.53	303.76	5478.84	0.5	262668.76
	Leverage (%)	54.16	45.63	189.4	0	10059.61
	Variables	Shareholding (%)	Education (1~5)	Board Seats	Total Assets (\$ M)	Leverage (%)
China Coefficient Matrix	Shareholding (%)	1	0.13***	0.11***	-0.01	-0.03*
	Education(1~5)	-	1	0.03*	0.07***	-0.02
	Board Seats	-	-	1	0.13***	-0.04**
	Total Assets(\$ M)	-	-	-	1	0.01
	Leverage (%)	-	-	-	-	1

Table 2(b). Analysis of Descriptive Statistics in Taiwan

Descriptive Statistics	Research Variables	Mean	Median	St. Dev.	Min	Max
Taiwan Number of Samples: 2991	Tobin's Q	1.28	1.06	0.74	0.33	10.01
	Market Value Added (US\$ M)	375.93	13.9	2363.93	-3748.73	58730.13
	ROA (%)	8.61	7.8	8.77	-89.8	56.05
	Shareholding (%)	21.58	18.24	13.71	1.12	98.07
	Education(1~5)	3.32	3.29	0.61	2	5
	Board Seats	7.35	7	2.67	3	21
	Total Assets (US\$ M)	2758	249.7	11207.84	2.21	178440.99
	Leverage (%)	45.3	43.81	20.51	1.73	7146.37
	Variables	Shareholding (%)	Education (1~5)	Board Seats	Total Assets (\$ M)	Leverage (%)
Taiwan Coefficient Matrix	Shareholding (%)	1	0	0.03	-0.07**	-0.05***
	Education(1~5)	-	1	0.13***	0.24***	0.06***
	Board Seats	-	-	1	0.34***	0.19***
	Total Assets(\$ M)	-	-	-	1	0.38***
	Leverage (%)	-	-	-	-	1

(1) Education degree: 5(Doctorate), 4(Master), 3(Bachelor), 2(High School), 1(below)

(2)*:p<0.05, **:p<0.01, ***:p<0.001

(3) Currency exchange rate is estimated by RMB\$1=US\$0.1635; NT\$1=US\$0.03283.

Table 3. Ownership Structure and Financial Performance

(a) China

Research Variables	Model 1		Model 2		Model 3	
	Tobin's Q		log(MVA)		ROA	
	Estimate	t-value	Estimate	t-value	Estimate	t-value
Intercept Term	1.934483***	40.90278	7.756948***	32.31876	5.096775	0.736938
(shareholding) ¹	-0.007017***	-6.986842	-0.029987***	-6.006626	0.039363	0.26796
(shareholding) ²	7.84E-05***	8.90E+00	0.00036***	8.241161	0.00047	0.36451
Education	0.051334***	7.217037	0.192018***	5.385046	1.950193*	1.871512
Seats	0.002618***	4.596014	0.011718***	4.136255	-0.018981***	-0.227777
Leverage	0.000198***	1.38E+01	0.000354***	5.026941	-0.595993	-9.364654
log(Total Assets)	-0.116636***	-48.06935	0.431596***	34.52533	-0.019606*	-1.678121
R-squared	0.329358		0.253989		0.177015	
Adj-R-squared	0.328672		0.253197		0.176173	
F-value	479.8947***		320.6031***		18.3954***	
N	5881		5881		5881	
Extremum (Shareholding Ratio)	44.75%		41.65%		Insignificant	

(b) Taiwan

Research Variable	Model 1		Model 2		Model 3	
	Tobin's Q		log(MVA)		ROA	
	Estimate	t-value	Estimate	t-value	Estimate	t-value
Intercept Term	0.17432*	2.120582	0.59484	1.792949	-6.094275***	-3.635823
(shareholding) ¹	-0.006018***	-3.375037	-0.001039	-0.143859	-0.030916	-0.850127
(shareholding) ²	0.0000949***	4.037474	6.92E-05	0.762201	0.000765	1.596414
Education	0.134244***	10.72057	0.283891***	5.285402	0.637356**	2.496036
Seats	0.000258	0.083079	-0.04235***	-3.308986	-0.350857***	-5.534986
Leverage	-0.0028***	-6.875834	-0.028402***	-16.67731	-0.180433***	-21.7381
log(Total Assets)	-0.007971	-1.376371	0.931596***	40.04525	1.513638***	12.82756
R-squared	0.065746		0.551075		0.150625	
Adj-R-squared	0.063867		0.549591		0.148957	
F-value	34.99852***		371.5361***		88.25210***	
N	2991		2991		2991	
Extremum (Shareholding Ratio)	31.71%		insignificant		Insignificant	

*:p<0.05, **:p<0.01, ***:p<0.001

Table 4. Factors that Affect the Shareholding Ratio in Extreme Point

(a) Estimation of Shareholding Ratio in the Extreme Point(China)

Board Education Level	Group	G1	G2	G3	G4	G5
	Means	2.71	3.14	3.34	3.52	3.79
	Extremum	48.72%	48.85%	45.02%	39.68%	insignificant
	Sensitivity			-62.08%		
Board Seats	Group	G1	G2	G3	G4	G5
	Means	12.37	14.57	16.33	18.42	24.80
	Extremum	43.57%	38.37%	29.28%	44.22%	34.59%
	Sensitivity			-20.50%		
Leverage (%) (Total Debts/ Shareholder's Equity)	Group	G1	G2	G3	G4	G5
	Means	14.68	32.07	45.64	58.76	89.97
	Extremum	58.42%	40.57%	22.17%	29.22%	50.55%
	Sensitivity*			-2.63%		
Total Assets (US\$ M)	Group	G1	G2	G3	G4	G5
	Means	91.57	183.24	299.43	562.25	3717.78
	Extremum	55.34%	52.97%	44.45%	28.44%	insignificant
	Sensitivity			-169.49%		

(b) Estimation of Shareholding Ratio in the Extreme Point (Taiwan)

Board Education Level	Group	G1	G2	G3	G4	G5
	Means	2.49	2.98	3.2	3.58	4.15
	Extremum	35.82%	28.64%	33.05%	33.01%	insignificant
	Sensitivity			-38.96%		
Leverage (%) (Total Debts/ Shareholder's Equity)	Group	G1	G2	G3	G4	G5
	Means	18.14	32.38	43.53	54.32	74.40
	Extremum	41.42%	insignificant	32.34%	27.92%	insignificant
	Sensitivity			-16.34%		

1. Some of the extremums are insignificant and cannot be located.

2. Sensitivity = percentage changes of extremums / percentage change of Means

3. Currency exchange rate is estimated by RMB\$1=US\$0.1635, NT\$1=US\$0.0328

Tobin's Q

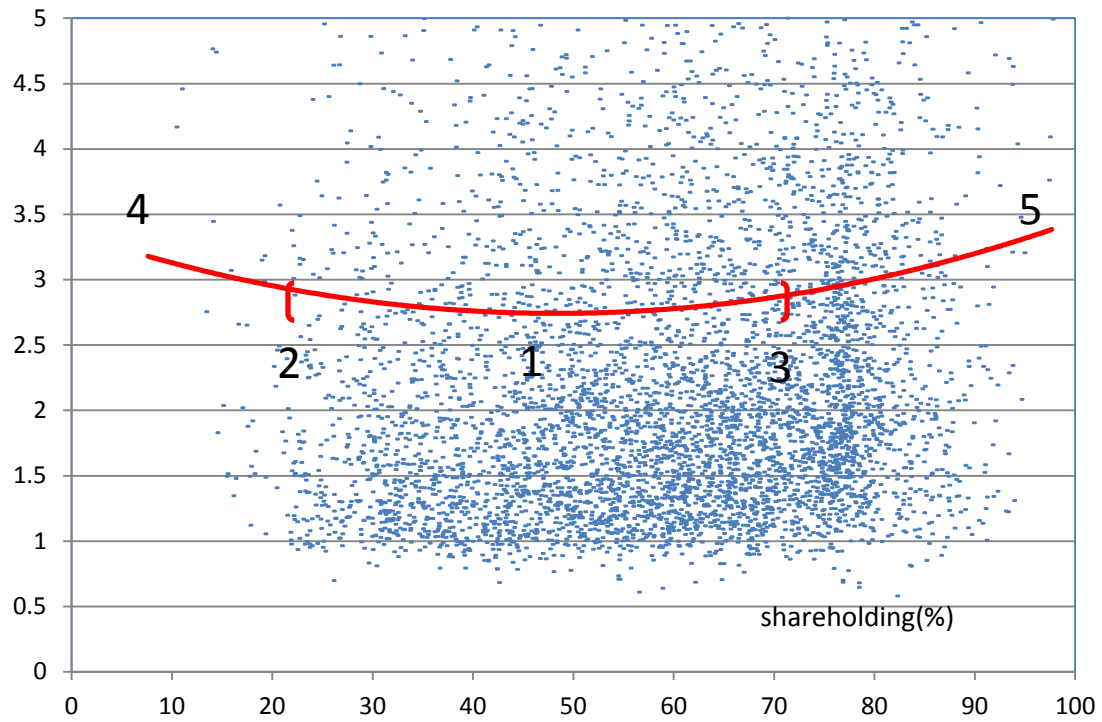


Figure 1(a). Shareholding Ratio of Board and Tobin's Q for Chinese Companies

1. Shareholding ratio at the extreme point of the non-linear relationship is 44.75%..
2. $Shareholding_{95\%lower}^* = 17.21\%$, $t_{95\%lower} = -3.74^{**}$, reject H_{04} .
3. $Shareholding_{95\%upper}^* = 72.28\%$, $t_{95\%upper} = 2.64^{**}$, reject H_{05} .
4. $Shareholding_{min} = 7.60\%$, $t_{min} = -5.44^{***}$, reject H_{06} .
5. $Shareholding_{max} = 97.67\%$, $t_{max} = 4.46^{***}$, reject H_{07} .
6. *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

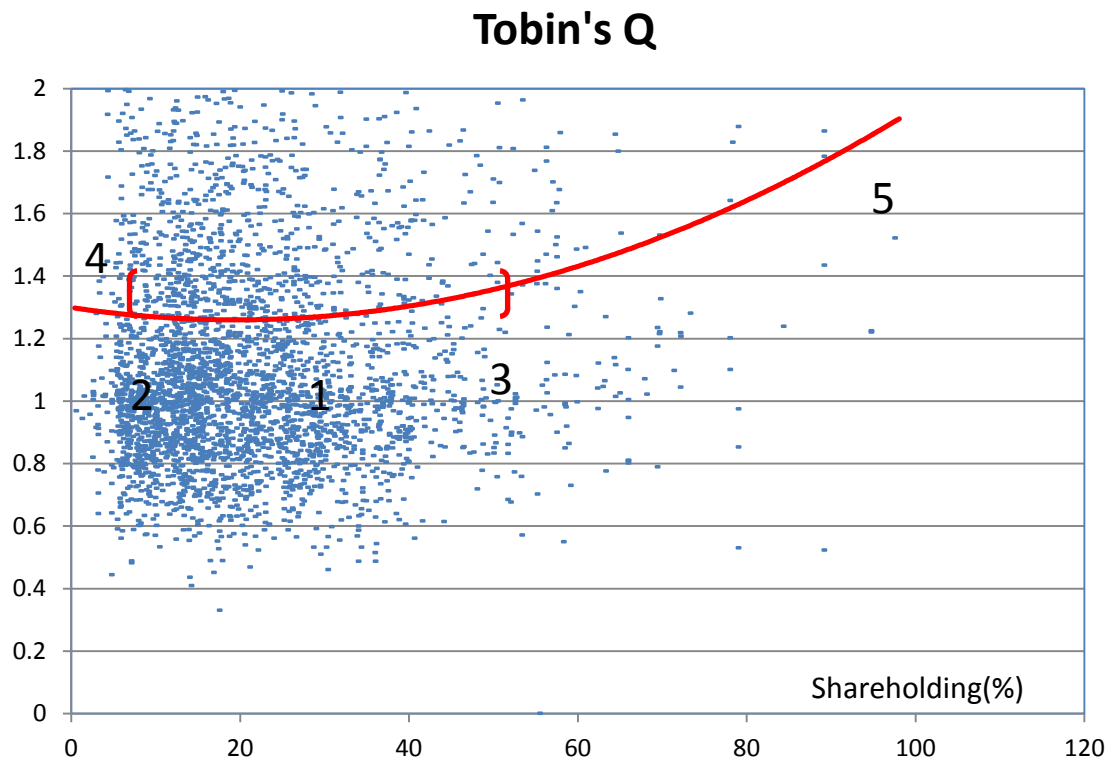


Figure 1(b). Shareholding Ratio of Board and Tobin's Q for Companies in Taiwan

1. Shareholding ratio at the extreme point of the non-linear relationship is 31.71%.
2. $Shareholding_{95\%lower}^* = 9.75\%$, $t_{95\%lower} = -2.66^{**}$, reject H_{04} .
3. $Shareholding_{95\%upper}^* = 54.88\%$, $t_{95\%upper} = 6.37^{***}$, reject H_{05} .
4. $Shareholding_{min} = 0.00\%$, $t_{min} = -3.37^{***}$, reject H_{06} .
5. $Shareholding_{max} = 98.07\%$, $t_{max} = 15.14^{***}$, reject H_{07} .
6. *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

Tobin's Q

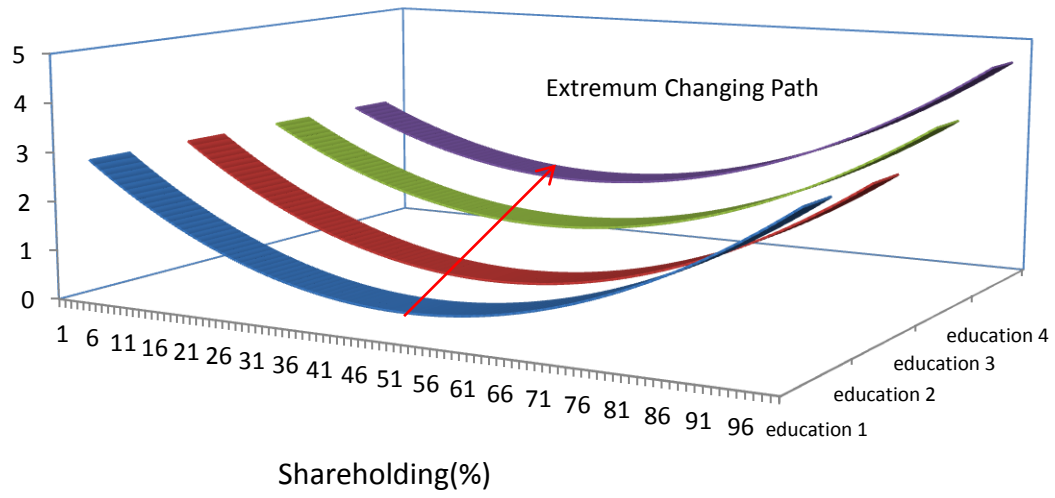


Figure 2(a). Influences of Education Level of Board on Extreme Point and Tobin's Q for Chinese Companies

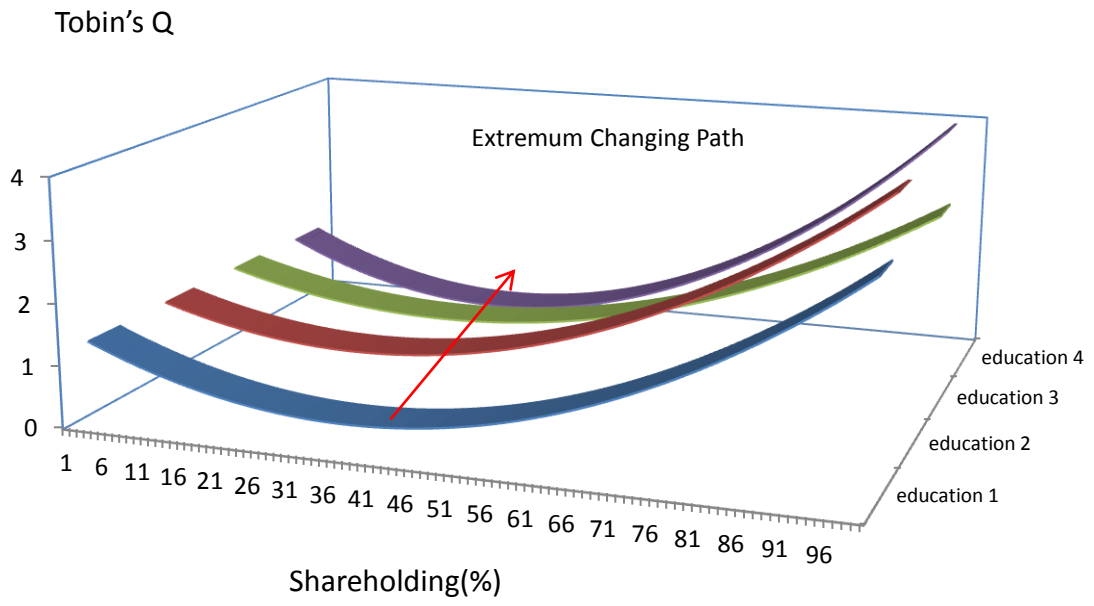


Figure 2(b). Influences of Education Level of Board on Extreme Point and Tobin's Q for Companies in Taiwan

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