

Effects of Intellectual Capital on Corporate Entrepreneurship and Value Creation: Evidence from Taiwan

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ABSTRACT

This study bases on a three-dimensional framework to measure firms' intellectual capital (IC) that includes human capital, intellectual property, and reputational capital. It mainly probes the effect of different dimension's IC on corporate entrepreneurship and corporate value. A sample of 58 companies is selected from new ventures in the electronic industry that issued an initial public offering (IPO) on the Taiwan Stock Exchange between 1995 and 2002. The results from this investigation indicate that the IC indeed has a significant impact on the corporate entrepreneurship and on the corporate value. A positive relationship exists between diversity of the top management team's educational backgrounds and firm's innovation activities. The reputational capital positively affects firm's innovation activities, venturing activities, and corporate value. However, the diversity of the top management team's educational levels and the intellectual property rights are negatively associated with corporate value. The empirical findings demonstrate that entrepreneurship makes for corporate value creation, and it plays a vital role in the mediating effect on the relationship between reputational capital and corporate value.

Keywords: Intellectual capital, Entrepreneurship, Innovation activities, Venturing activities, Corporate value

INTRODUCTION

Technology innovation and advancement has led to a shift in the Taiwanese industrial structure from traditional labor-intensive industry to high-value-added high-tech industry. Building innovation-based industrial structure became the mainstream of Taiwanese economy and, as a result, Taiwanese high-tech industry holds an important place in the world. Under these circumstances, a new corporation's success depends largely on its resources, innovation and the competition (Christensen, 1997; Zahra and Bogner, 2000). New high-tech corporations are showing more entrepreneurship, which translates into persistent innovation and frequent venturing activities. High levels of entrepreneurship help a new corporation successfully develop products and enter the market and give the corporation a competitive advantage, which will allow it to generate better market results and improve corporate value (Deng, Lev and Narin, 1999; Hamel and Prahalad, 1994; Morck and Yeung, 1991; Sougiannis, 1994; Toivanen, Stoneman and Bosworth, 2002; Zahra and Covin, 1995).

In the current economic environment, owning tangible assets and having financial resources does not necessarily equal competitive advantage. The corporation's ability to utilize intellectual capital will become the key to competitiveness (Tseng and Goo, 2005). How intellectual capital is formed has never been clearly defined. Overall, intellectual capital is used to create financial knowledge, information and intellectual property rights (Stewart, 1997). From the resource-based view, concretizing unique resources allows the corporation to create better products and gain a market advantage. From the perspective of knowledge-based theory, knowledge is created through the process of systemizing corporate resources and, with proper management, corporate knowledge can be utilized to great benefit. Utilizing systematic knowledge helps to increase the value of the corporation, which will allow the corporation to gain competitive advantage. Technological advancement and fierce competition forces corporations to incorporate intellectual capital into operating activities to give the corporation a competitive edge in the market.

Many studies on intellectual capital have focused on the cross-section between intellectual capital on one hand and corporate operational results and value on the other. However, few researches focused on intellectual capital integration with entrepreneurship and the effect of that integration on corporate value following the IPO. Ways that IPOs can utilize intellectual capital to manage the corporation and increase competitive edges, as well as ways to concretize intellectual capital, are topics industry professional and academic scholars hope to understand better. Thus, this paper focuses on new Taiwanese high-tech companies' competitiveness in relation to intellectual capital, which is constructed by human capital, intellectual property, and reputational capital. The main purpose of the present research is to analyze the internal arrangements among firms' intellectual capital, entrepreneurship, and corporate value and to assess the effect of time lag, which can help to explain the value of intellectual capital in high-tech corporations.

The literature has often focused on two of the following three topics: intellectual capital, entrepreneurship and corporate value (Bosworth and Roger, 2001; Zahra and Garvis, 2000). Previous studies have already demonstrated the relationship between intellectual capital and corporate value (Tseng and Goo, 2005). Although Hayton (2005) pointed out that, when high-tech corporations issue an IPO, intellectual capital has an influence on the company's ability to create new business in the future, Hayton did not

discuss the relationship between entrepreneurship and corporate value. The present study seeks to fill this gap in the literature. Our view is that, because intellectual capital has an effect on entrepreneurship, corporate value will vary depending on the level of entrepreneurship. Moreover, entrepreneurship may play an important role on the relationship between intellectual capital and corporate value. Thus, a company's intellectual capital will affect corporate value through the mediating effect of entrepreneurship.

This study found that a higher heterogeneity in educational backgrounds among members of the top management team would have a positive effect on firm's innovation activities. Conversely, a higher heterogeneity in educational levels among members of the top management team would create a tendency to waste time during the decision-making process, which would hurt company's performance, and hence, impair firm's value. We also found that the intellectual property rights is negatively associated with corporate value. In addition, the empirical analysis indicates that a corporation's reputational capital positively influences its entrepreneurship (innovation activities and venturing activities) and value following the IPO. Since both innovation activities and venturing activities have a positive influence on firm's development of new products and entrance into a new market, the company is able to gain better financial results, and consequently, enhance corporate value. The results arising from the investigation of the mediating effect of entrepreneurship on the relationship between intellectual capital and corporate value show that entrepreneurship has a strong mediating effect on the relationship between the reputational capital and corporate value. This finding is evidence that accumulation of firm's reputation will be through the mediating effect of entrepreneurship to create corporate value.

The paper is organized as follows. Section 2 briefly reviews the theoretical bases and develops the research hypotheses. Section 3 presents an overview of our data and methodology. Section 4 discusses the empirical investigation results, and Section 5 concludes the study.

THEORETICAL BASIS AND RESEARCH HYPOTHESIS

In order to discuss the effect of intellectual capital on entrepreneurship and on corporate value, this paper first plotted a research framework in figure 1 to introduce the theoretical basis and research hypotheses.

2.1 Theoretical Basis

Three related theories are utilized, including resource-based view, knowledge-based theory and financial point of view.

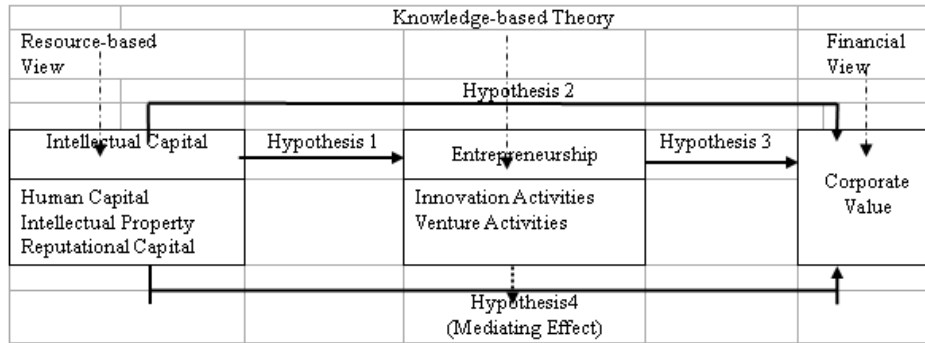
2.1.1 Resource-based View

Wernerfelt (1984) was the first to use the term "resource-based view". He found that, through proper utilization of resources and efficient resource management, corporations can maintain and preserve resource advantages that competitors cannot have, giving a corporation a long-lasting competitive edge. The resource-based view assumes that the formation of various resources exists heterogeneity. The corporations' key resources result primarily from internal development, rather than external purchase. Herremans and Isaac (2004) had adopted the resource-based view to develop the intellectual capital realization

process. Their findings could help top management to determine whether the current strategic direction of the organization appears appropriate.

Using the resource-based view, we are able to construct the types of intellectual capital a corporation owns and explore how intellectual capital influences Taiwanese high-tech industry's company following the IPO, especially in the aspect of the effect on entrepreneurship and the effect on corporations' value creation.

Figure 1: Research Framework



2.1.2 Knowledge-based Theory

Knowledge-based theory notices that knowledge is not only the collection of data and information, but is a systemization of instinct, experience and reality. Knowledge is made of elements such as information, technology, know-how and skill. Utilizing knowledge can help to increase the value of products and gain a competitive edge. There are various types of knowledge, including which comes from either the individual or the group, thus the essential job for a corporation is to learn how to control and utilize them. By properly utilizing organizational structure and knowledge management, the company can efficiently create knowledge to increase corporate value. Different knowledge can be utilized to solve different problems; through the systematic integration of individual knowledge, new knowledge can be gained, and through effective communication with members of the corporation, competitive advantage can be realized.

Kjaergaard (2003) used intellectual capital statements as a new way of defining and working with company strategic resources and demonstrated that it benefits a company to achieve a way of constructing a new knowledge-based identity. Schiuma, Lerro and Sanitate (2008) also employ a case study of the Ducati Motor Holding to verify the relevance of taking into consideration the development of knowledge assets to carry out a successful change management program. Under the same theory framework, we will explore how to utilize intellectual capital for increasing entrepreneurship, and hence, creating corporate value.

2.1.3 Financial Point of View

From the financial point of view, the research of intellectual capital primarily focuses on understanding corporate value (Steward, 1997). Studies have utilized different ways to measure corporate value. For example, the net present value method calculates expected return and future cash flow, while Tobin's q is often utilized to measure the company's

market value and the effectiveness of corporate operation. Tobin's q is the ratio of corporate market value to replacement cost of the assets in place and is used to measure corporate intangible assets and future growth opportunities. Huang and Wang (2008) indicate that in addition to book value, intellectual capital does provide incremental information for the evaluation of firms.

2.2 Constructing Hypotheses

In 1969, the idea of intellectual capital was advanced by economist Galbraith, who used it to explain the difference between corporate market value and book value. Later, because of the advancement of high-tech industry, many scholars evolved research in the field of intellectual capital. The literature contains a number of definitions of intellectual capital. In general, definitions tend to focus upon the intangible aspect, in which intellectual capital can be defined as valuable knowledge, useful skill, experience and information. Intellectual capital brings about competitiveness within a corporation and creates corporate value. Hayton (2005) compared number of studies and summarized the assets to comprise intellectual capital including human capital, intellectual property, relationships with external stakeholders (called as reputational capital) and structural capital. Hall (1993) argues that intangible resources represent the feedstock of the capability differentials of corporate that in turn result in sustainable competitive advantage. To include structural capital within the definition of intellectual capital, therefore, confuses the distinction between resources as feedstock and the capabilities that they feed. Thus, we follow Hayton's (2005) proposed three-dimensional framework to measure firms' intellectual capital that includes human capital, intellectual property, and reputational capital.

Prior researches on entrepreneurship have focused primarily on entrepreneurs' individual characteristics, but the focus has recently shifted to the exploration of entrepreneurial behaviors. Scholars often view innovation and risk-taking as main elements of entrepreneurship. The essence of entrepreneurship, whether in an individual or a corporation, is the ability to innovate, discover and organize. These abilities can be utilized in a corporate operation in pursuit of better performance and to increase the corporation's core abilities. We adopted Hayton's (2005) view in considering entrepreneurship as the combination of innovation activities and venturing activities.

On the other hand, researches on whether the educational credentials of the top management team positively affected the new ventures still had mixed findings. Westhead (1997) found no differences in innovation between university-based start-ups and independent high-technology start-ups in regard to the number of new products and services launched to existing customers and new markets. Also, George, Zahra, and Wood (2002) found that university-based start-ups do not necessarily achieve greater financial performance than the independent ones. These results are inconsistent with the findings from Hayton's study. Therefore, this study would utilize observing innovation activities and venturing activities to explore the relationship between intellectual capital and entrepreneurship, and even corporate value.

2.2.1 Relationship between Intellectual Capital and Entrepreneurship

Human capital is associated with knowledge, technology and the ability of employees. Hayton (2005) studied the relationship between human capital and entrepreneurship in terms of heterogeneity and accumulation of human capital. Hambrick and Mason (1984) suggested that the cognitive ability and values of members in the top management team

have significant impact on the company's strategy. Experience in the profession and educational training can show the characteristics of managers in this regard. Furthermore, the personal backgrounds and heterogeneity of the educational levels of top managers also affect decision-making which, in turn, affects the company's strategy and performance (Simons, Pelled and Smith, 1999).

A number of studies have indicated that experience, education and training, and other learning experiences of the entrepreneurs and members of the top management team are related to the success of the corporation (e.g., Chandler and Hanks, 1998; Cooper, Gimeno-Gascon and Woo, 1994; Honig, 1998; MacMillan, Zemann and SubbaNarasimha., 1987; Stuart and Abetti, 1990). Therefore, the success of the enterprise can be attributed to the impact of both the accumulation and the heterogeneity of human capital on decision-making strategy and innovation. Better cognitive ability helps one to better understand the issue in a decision-making situation and to come up with systematic plans for resolving problems. Empirical researches have shown that education, awareness and wisdom, and other characteristics are related to innovation (e.g., Amabile, 1983; Oldham and Cummings, 1996; Woodman and Schoenfeldt, 1989) and entrepreneurship (e.g., Kimberly and Evanisko, 1981; Rogers and Schoemaker, 1971).

Because upper-level managers play a key role in the decision-making process, characteristics of the top management team have especially a great influence on entrepreneurship-oriented start-ups. Bantel and Jackson's (1989) empirical analysis revealed that the educational levels of the top management team and heterogeneity of their educational backgrounds are positively correlated with innovation activities. Similarly, Wiersema and Bantel (1992) found that the top management team's education, training in science and the heterogeneity of their profession are also positively correlated with the company's strategy preferences (which can be a proxy for the willingness to participate in venturing activities). Hayton (2005) provided evidence that the heterogeneity of the educational backgrounds of the top management team has a positive impact on company's innovation activities and venturing activities.

Based on previous literature, the unique characteristics of the top management team seem to be correlated with entrepreneurship, thus, we develop hypotheses as:

Hypothesis 1-1a: The human capital of the top management team and the company's innovation activities are positively related.

Hypothesis 1-2a: The human capital of the top management team and the company's venturing activities are positively related.

Intellectual property rights can be defined as the ownership of intellectual assets as protected by law. Patents, copyrights, trademarks, trade secrets, and so on can be categorized as intellectual property. Organizations can gain intellectual property rights, which represent the ownership of a technological advantage, through internal development or external purchase (Porter, 1980). This advantage will enable a company to enter new markets or to use a new process technology more promptly. Relevant evidences reveal that most development of intellectual property rights is focused on invention (e.g., Chakrabarti and Lenard, 1993; Griliches, 1998). As company's patent rights are the result of research and development activities, the number of patents a company owns can be regarded as corporate knowledge assets and successful experiences in research and development. Patents, in turn, can be treated as a leading indicator of the company's plans to continue innovation activities (Deng, Lev and Narin, 1999).

Moreover, patents, which represent the company's level of technological advancement, are able to increase available resources such as financial capital and alliance partners (Deeds, DeCarolis and Coombs, 1997).

If owning patents enable company to impede competitors' access to technology and enhance profitability from increasing R&D investment, intellectual property rights will help to change the risks and returns arising from innovation and venturing activities for the business into new market. The resulting hypotheses are:

Hypothesis 1-1b: Intellectual property rights have a positive relationship with innovation activities.

Hypothesis 1-2b: Intellectual property rights have positive relationship with venturing activities.

Reputation can be defined as the representation of actions in the past and the future prospects and the key to attracting one to the company when compared to competitors (Fombrun, 1996). The accumulation of reputation cognition is called as reputational capital in this research. Usually, companies accumulate their reputational capital through media reports. When there is incomplete information regarding one's interests, the company's reputation can have a tremendous influence on stakeholders' beliefs, attitudes and behavior (Weigelt and Camerer, 1988).

Corporations may use their reputations to reduce the perceived risk of a transaction, which will help increasing the stakeholders' willingness to trade with the company (Erdem, 1998; Smith, 1992). In addition, positive reputation can help to attract potential stakeholders as well as reduce transaction costs and contract costs (Beatty, 1989; Lovett, Simmons and Kali, 1999; Michaely and Shaw, 1995; Williamson, 1975; Xin and Pearce, 1996). Such results will increase available resources, reduce the cost of access to resources, and increase flexibility in the use of resources. Since entrepreneurship generally consumes considerable resources (Covin and Slevin, 1991; Guth and Ginsberg, 1990; Romanelli, 1987), there is a particularly high demand for resources for start-ups (Greene and Brown, 1997), and a good reputation will help to reduce resource constraints. Therefore, reputational capital accumulated by the corporation should be expected to be positively correlated with entrepreneurship. Therefore, we hypothesize that:

Hypothesis 1-1c: Reputational capital has a positive relationship with innovation activities.

Hypothesis 1-2c: Reputational capital has a positive relationship with venturing activities.

2.2.2 Relationship between Intellectual Capital and Corporate Value

Based on the upper-echelons theory, because the members of the top management team are the organization's policy strategists, individual manager's characteristics have a major impact on the organization output (Boeker, 1997; Hambrick and Mason, 1984; Knight et al., 1999). Accordingly, many researches have focused on the relationship between the composition of the top management team and the financial performance. They have found that the characteristics and heterogeneity of the top management team indeed affect the company's operating performance. A well educated management team has a positive impact on business performance (Goll, Sambharya and Tucci, 2001; Norburn and Birley, 1988). The lower heterogeneity of educational levels among

members of the top management team, the better company's operating performance is likely to hold (Goll, Sambharya and Tucci, 2001; Pegels, Song and Yang, 2000). However, there also have empirical studies indicated that the heterogeneity of the top management team's educational levels has a positive relationship with business performance (Hambrick, Cho and Chen, 1996). In addition, the larger the top management team, the more it can promote the growth of corporation and, in turn, enhance the company's operating performance (Eisenhardt and Schoonhoven, 1990; Hambrick and D'Aveni, 1992).

Several studies have already demonstrated that the educational levels of the top management team can affect the company's operating performance. The present study infers that if the good operating performance of a company can be attributed to its well educated top management team, this message should induce the market to give the company a positive assessment, thereby help to improve the company's value. Therefore, we develop the hypothesis that:

Hypothesis 2a: The human capital of the top management team has a positive relationship with corporate value.

Intellectual property can be seen as the output of an investment in the manufacturing process, product innovation and production activities, which can protect the company's future income and enhance corporate value (Karakaya and Kobu, 1994). Similarly, patents provide guarantees of return on innovation activities as well as incentives for research and development (Arora, Ceccagnoli and Cohen, 2003). Pakes (1985) points out that the number of patents is a good indicator for a company's research and development activities and has a positive correlation to operating performance. Moreover, several studies have revealed that the number of patents that a company owns has a positive relationship with corporate value (Bosworth and Rogers, 2001; Hall, Jaffe and Trajtenberg, 2005; Hall, Thoma and Torrisi, 2006; Megna and Klock, 1993). Thus, focusing on high-tech start-ups, we hypothesize that:

Hypothesis 2b: Intellectual property rights have a positive relationship with corporate value.

In general, potential stakeholders often have incomplete information about start-ups and are skeptical about their management skill and product quality control. Thus, good reputation of start-ups can help to guarantee corporate value and reduce the distrust arising from potential stakeholders. In addition, a corporation with good reputation often has more opportunities to expand its existing network of relationships, which will help to reduce competitors' mobility (Caves and Porter, 1977; Wilson, 1985), establish competitive advantage (Fombrun and Shanley, 1990), and set a higher selling price (Klein and Leffler, 1981; Milgrom and Roberts, 1986). These positive effects of a good corporate reputation will enhance a company's operating performance and assist in measuring the true value of a company in the market (Beatty and Ritter, 1986; Riahi-Belkaoui, 1999a, 1999b). Several studies have also argued that a positive relationship exists between company's reputation and corporate value (e.g., Black, Carnes and Richardson, 1999; Dowling, 2006; Riahi-Belkaoui, 2003).

Yiu and Lau (2008) follow to indicate that reputational capital, one of network-based resource capitals, is critical in providing firms with special access to various resources

and legitimacy in emerging markets. They obtained evidence from a survey of established firms in China and argued that the positive effect of reputational capital on firm performance is channeled through the resource configuration process given by various corporate entrepreneurial activities. We would like to examine whether the same relationship exists in Taiwanese high-tech start-ups. Thus, we hypothesize that:

Hypothesis 2c: The reputational capital of high-tech start-ups has a positive relationship with corporate value.

2.2.3 Relationship between Entrepreneurship and Corporate Value

Entrepreneurship, including innovation activities and venturing activities, helps enterprises to develop new products and find new markets, which enhance its competitive advantage (Narver and Slater, 2000; Schollhamer, 1982). Prior research has found that entrepreneurship has a significantly positive impact on business operating performance and profitability (Becherer and Maurer, 1997; Matsuno, Mentzer and Ozsomer, 2002; Morris and Sexton, 1996; Zahra and Garvis, 2000; Zahra, Ireland and Hitt, 2000; Zahra, Nenbaum and Huse, 2000). In addition, Myers (1977) suggests that corporate value results from assets in place, as well as from growth opportunities, and entrepreneurship will elevate a company's growth opportunities. Several empirical studies have also shown that entrepreneurship promotes value-relevant information and entrepreneurship has an effect on enhancing corporate value (Deng, Lev and Narin, 1999; Moreck and Yeung, 1991; Sougiannis, 1994; Toivanen, Stoneman and Bosworth, 2002). Thus, we develop the hypotheses that:

Hypothesis 3-1: Innovation activities have a positive relationship with corporate value.

Hypothesis 3-2: Venturing activities have a positive relationship with corporate value.

2.2.4 Mediating Effect of Entrepreneurship

Hayton (2005) mentions that, when a high-tech start-up issues an IPO, the company's intellectual capital will influence its future entrepreneurship. However, Hayton did not explore the relationship between entrepreneurship and corporate value. Prior literature has focused on only two of the three elements of intellectual capital, entrepreneurship and corporate value. Since intellectual capital might affect the performance of a company's entrepreneurship, and corporate value might vary depending on the level of entrepreneurship, we suggest that entrepreneurship might play a mediating role in the relationship between intellectual capital and corporate value. That is, intellectual capital through the mediating effect of entrepreneurship could influence a company's operating performance and enhance corporate value. Thus, we hypothesize that:

Hypothesis 4a: Human capital in high-tech start-ups influences corporate value through the mediating effect of entrepreneurship.

Hypothesis 4b: Intellectual property rights in high-tech start-ups influence corporate value through the mediating effect of entrepreneurship.

Hypothesis 4c: Reputational capital in high-tech start-ups influences corporate value through the mediating effect of entrepreneurship.

METHODOLOGY

3.1 Definitions and Measures of Variables

3.1.1 Entrepreneurship

(1) Innovation Activities (INN)

Harhoff (1998) suggested that using input from corporate research and development projects could not fully explain the results of innovation activities. Instead, it is more appropriate to use the output from such activities to measure the results. Several studies have adopted the number of patents as a proxy for innovation activities. The intellectual capital influences firms' innovation activities, while there is a time lag for the output arising from innovation activities. Therefore, this study utilizes the number of patent applications over 2-year period following the IPO as a measure of the innovation activities.

(2) Venturing Activities (VEN)

Generally speaking, venturing activities refer to a company's efforts to expand its business into a new or existing product markets, engage in joint activities with other organizations, takeover other companies in a different industry or market, or offer different products (Block and MacMillan, 1993). The intellectual capital generates firms' venturing activities, while the outcome arising from venturing activities is not apparent immediately. Following Hayton's (2005) research, this study uses the number of acquisitions, joint ventures, and strategic alliances over 2- year period after the IPO as a measure of the venturing activities.

3.1.2 Corporate Value (VALUE)

Tobin's q value is the ratio of the market value to the replacement cost of assets in place (Tobin, 1969). Because the replacement cost information is unlikely to obtain, this study adopted a relatively simple approximation of Tobin's q developed by Chung and Pruitt (1994) to measure the true value of the company. The calculation is as follows:

$$\text{Tobin's } q = \frac{\text{Market value of equities} + \text{Book value of liabilities} - \text{Book value of current assets}}{\text{Book value of total assets}}$$

where the market value of equities is the aggregate market value of both common stocks and preferred stocks. The book value of liabilities is measured by the book value of both long-term liabilities and short-term liabilities. The book value of current assets is measured by the book value of firm's short-term assets, such as cash, inventories, accounts receivable, short-term investment, prepaid expenses, etc. The book value of total assets is the aggregate book value of short-term assets, long-term assets and other assets. Because the intellectual capital that generates corporate value might have a time lag effect, we utilize the Tobin's q at the end of second year following the IPO to measure corporate value.

3.1.3 Intellectual Capital

(1) Human Capital

In this paper, human capital refers to the human capital of the top management team at the point of IPO, which includes the chief executive officer, and directors, staffs, and operating managers on the two levels below the CEO. We measure human capital by five specific variables, including the average educational level of the top management team (TED), the average educational level of the top management team in natural science (TEDINS), the size of the top management team (TS), the heterogeneity of the educational levels of the top management team (TEDH), and the heterogeneity of the educational backgrounds of the top management team (TEDHB).

Several steps are used to calculate the average educational levels (TED, TEDINS). First, we assign a seven-point Likert scale to score the educational level of members in the top management team: 1 for a primary education, 2 for a junior high school education, 3 for a senior high school education, 4 for a college degree, 5 for a university degree, 6 for a master degree, and 7 for a doctoral degree. Then we sum up the points of all members in the top management team and take the average value; this average value will be the average educational levels of the top management team. The size of the top management team (TS) is based on the information from each company's prospectus and derived by the actual members of the top management team. To estimate heterogeneity

(TEDH, TEDHB), we use Blau's (1977) index of heterogeneity ($H = 1 - \sum_i P_i^2$), where P_i represents the proportion of group members in the i th educational level (or background) and n denotes the number of different educational levels (or backgrounds). H is between 0 and 1, and a lower H value means lower heterogeneity or higher homogeneity. The educational levels are divided into seven categories, as described above. The educational backgrounds are divided into three categories, they are business, natural sciences and humanities.

(2) Intellectual Property Rights (PAT)

Since patents are the result of company research and development activities, the number of patents a company owns could be regarded as the expression of corporate specific knowledge and successful experiences in research and development. Patents enhance corporate value and serve as a leading indicator of innovation activities (Deng, Lev and Narin, 1999). Based on this concept, this study uses the sum of all patents authorized up to the year of IPO (hereafter, PAT) as a proxy for intellectual property rights.

(3) Reputational Capital (ME)

Previous researches on corporate reputations have suggested that financial and accounting measures of risk and performance, product price, and media exposure are important signals that influence stakeholder perceptions of a company (Fombrun and Shanley, 1990; Milgrom and Roberts, 1986). This study focuses on media exposure (hereafter, ME) and treats it as a proxy for reputational capital. Following Hayton's (2005) research, the reputational capital is measured by the average number of media exposures in the 3 years prior to the IPO.

3.1.4 Control Variables

This study puts the age of a company and the degree of globalization into the regression model as control variables.

(1) The age of a company (AGE)

Chandler and Hanks (1998) point out that the age of a company influences the company's growth opportunities. Growth opportunities may also be related to both innovation and venturing activities. Based on Hayton's (2005) findings, we measure the age of a company by the number of years at date of issued an IPO.

(2) The degree of globalization (GL)

Sharing resources internationally promotes the company's core competencies and efficiency. In addition, how to create and maintain a competitive edge and how to establish a strategic organization will also be important issues of globalization. This research adopts a dummy variable that equals one if the company's export ratio is more than 25% of total sales, and zero otherwise.

3.2 Empirical Models

3.2.1 Multiple Regression Analysis Model

To clarify the relationship between intellectual capital, entrepreneurship and corporate value, with controlling the age of a company history and degrees of internationalization, this study employs regression models for analysis. Because intellectual capital might affect future strategies and future performance, it might have a time lag effect. Accordingly, this study follows prior literature in the field of entrepreneurship research, the variables for innovation activities (INN) and venture activities (VEN) are measured over two years period following the IPO (Chandy and Tellis, 2000; Hayton, 2005; Walker, Jeanes and Rowlands, 2002; Zahra, 1996). In below models, t denotes the year of the firm issued an IPO, $t+1$ denotes the first year following the IPO, and $t+2$ denotes the second year following the IPO. $(t+1, t+2)$ represents the two-year period observed values.

Model 1: To measure the relationship between intellectual capital and entrepreneurship, and to verify Hypothesis 1.

$$\begin{aligned} \text{INN}_{i,(t+1,t+2)} &= \beta_{10} + \beta_{11}\text{TED}_{i,t} + \beta_{12}\text{TEDINS}_{i,t} + \beta_{13}\text{TS}_{i,t} + \beta_{14}\text{TEDH}_{i,t} + \beta_{15}\text{TEDHB}_{i,t} + \\ &\quad \beta_{16}\text{PAT}_{i,t} + \beta_{17}\text{ME}_{i,t} + \beta_{18}\text{AGE}_{i,t} + \beta_{19}\text{GL}_{i,t} + \\ &\quad \varepsilon_{i,(t+1,t+2)} \dots\dots\dots (1) \\ \text{VEN}_{i,(t+1,t+2)} &= \beta_{20} + \beta_{21}\text{TED}_{i,t} + \beta_{22}\text{TEDINS}_{i,t} + \beta_{23}\text{TS}_{i,t} + \beta_{24}\text{TEDH}_{i,t} + \beta_{25}\text{TEDHB}_{i,t} + \\ &\quad \beta_{26}\text{PAT}_{i,t} + \beta_{27}\text{ME}_{i,t} + \beta_{28}\text{AGE}_{i,t} + \beta_{29}\text{GL}_{i,t} + \\ &\quad \varepsilon_{i,(t+1,t+2)} \dots\dots\dots (2) \end{aligned}$$

Model 2: To measure the relationship between intellectual capital and corporate value, and to verify Hypothesis 2.

$$\begin{aligned} \text{VALUE}_{i,t+2} &= \gamma_{10} + \gamma_{11}\text{TED}_{i,t} + \gamma_{12}\text{TEDIN}_{i,t} + \gamma_{13}\text{TS}_{i,t} + \gamma_{14}\text{TEDH}_{i,t} + \gamma_{15}\text{TEDHB}_{i,t} + \\ &\quad \gamma_{16}\text{PAT}_{i,t} + \gamma_{17}\text{ME}_{i,t} + \gamma_{18}\text{AGE}_{i,t} + \gamma_{19}\text{GL}_{i,t} + \\ &\quad \varepsilon_{i,t+2} \dots\dots\dots (3) \end{aligned}$$

Model 3: To measure the relationship between entrepreneurship and corporate value, and to verify Hypothesis 3.

$$\begin{aligned} \text{VALUE}_{i,t+2} &= \gamma_{20} + \gamma_{21}\text{INN}_{i,(t+1,t+2)} + \gamma_{22}\text{VEN}_{i,(t+1,t+2)} + \\ &\quad \varepsilon_{i,t+2} \dots\dots\dots (4) \end{aligned}$$

The three models follow the definition and measurement of variables explained as above.

3.2.2 Hierarchical Regression Analysis

Since hierarchical regression analysis can help in exploring specific relationships among variables, we utilize it to verify hypothesis 4, that entrepreneurship has a mediating effect on the relationship between intellectual capital and corporate value. According to Baron and Kenny's (1986) formulation, verification of a mediating effect

must meet the following three conditions: first, the independent variable must significantly affect the mediator; second, the independent variable must significantly affect the dependent variable; and third, the mediator must significantly affect the dependent variable. If these conditions all hold in the predicted direction and the effect of the independent variable on the dependent variable is less in the third equation than in the second one, then there exists a mediating effect. Perfect mediation holds if the independent variable has no effect when the mediator is controlled. Prior literature has adopted the same method to explore mediating effects (e.g., Hill and Snell, 1988; Poelmans, 2001).

Since intellectual capital will affect the performance of entrepreneurship and corporate value might change as a result of entrepreneurship, this study sets entrepreneurship as the mediator on the relationship between intellectual capital and corporate value. When intellectual capital has a significant association with corporate value, and then this association becomes weaker or insignificant after the inclusion of entrepreneurship in the equation, entrepreneurship might be the mediator on the relationship between intellectual capital and corporate value. That is, intellectual capital will affect corporate value through the mediating effect of entrepreneurship. The models for hierarchical regression analysis in this study are as follows:

Model 4-1: To verify the relationship between intellectual capital (independent variable) and entrepreneurship (the mediator). Model 4-1's equations are the same as those for Model 1.

Model 4-2: To verify the relationship between intellectual capital (independent variable) and corporate value (dependent variable). Model 4-2's equation is the same as that for Model 2.

Model 4-3: To verify the relationship between entrepreneurship (the mediator) and corporate value (dependent variable). Model 4-3's equation is the same as that for Model 3.

Model 4-4: To verify the relationship between intellectual capital, entrepreneurship, and corporate value and to verify the existence of a mediate effect (Hypothesis 4).

$$\begin{aligned} \text{VALUE}_{i,t+2} = & \omega_0 + \{\omega_1 \text{TED}_{i,t} + \omega_2 \text{TEDINS}_{i,t} + \omega_3 \text{TS}_{i,t} + \omega_4 \text{TEDH}_{i,t} + \omega_5 \text{TEDHB}_{i,t} + \\ & \omega_6 \text{PAT}_{i,t} + \omega_7 \text{ME}_{i,t} + \omega_8 \text{AGE}_{i,t} + \omega_9 \text{GL}_{i,t}\} + \{\omega_{10} \text{INN}_{i,(t+1,t+2)} + \\ & \omega_{11} \text{VEN}_{i,(t+1,t+2)}\} + \varepsilon_{i,t+2} \dots\dots\dots (5) \end{aligned}$$

3.3 The Sample and Data

The 2001 Industrial Investment Survey showed that, beginning in 1994, Taiwanese enterprises focused on research and development activities, particularly in the electronic industry. Thus, this study focuses on the companies in the electronic industry. The criteria for the sampling process are as follows:

- (1) Sample companies should belong to the electronic industry and trade in the Taiwanese stock market between 1995 and 2002. There are 290 firms in the preliminary sample.
- (2) In general, the business at start-up stage of an enterprise is usually 2 to 10 years. This study adopts prior literature to define start-up as a company issued an IPO in its first ten years. Companies that had been established for more than 10 years were deleted. This criterion ruled out 147 companies from the sample.
- (3) To ensure obtaining the required data, companies with less than 2 years following the IPO were excluded, which deleted only one company.
- (4) According to the US National Science Foundation's definition, named a high-tech

company as the research and development expenditure is more than 3% of total sales. Therefore, included in the sample are firms with the average research and development expenditures more than 3% of total sales in the 3 years prior to the IPO. This criterion removed 62 companies from the sample.

- (5) Companies that being suspended, acquired by other company or incomplete information during the study period were deleted, which removed 22 companies.

As shown in Table 1, the final sample consists of 58 companies selected to participate in the empirical analysis.

Table 1: Sample Selection Process

Preliminary samples	290
Less: established over 10 years	(147)
less than 2 years following the IPO	(1)
R&D expenditure less than 3% of total sales	(62)
being suspended, acquired or incomplete information	(22)
The final sample	58

Data for this paper came from several sources. Information about companies' venturing activities and the top management team was derived from the Securities and Futures Markets Development Foundation Website's Securities Database. Information about companies' innovation activities and intellectual property rights came from the Taiwanese Department of the Patent Information, using the Patent Information Inquiry System. Information regarding company reputation came from the Taiwan Daily News Network. Information regarding Tobin's q calculation, age of company and globalization of a company came from the *Taiwan Economic Journal* database.

EMPIRICAL RESULTS

4.1 Preliminary Analysis

The means and standard deviations of each variable and analysis of the correlation between variables are presented in Table 2. The average educational level of the top management team (TED) falls between university degree and master degree (5.45). Some companies have no one with master degree or doctoral degree in the top management team, perhaps because, when Taiwan first entered the electronic industry, most of the jobs were labor-oriented jobs that placed less emphasis on academic qualifications. The average size of top management team (TS) is 9.36 people. The number of approved patents (PAT), as a proxy for intellectual property rights, averaged 3.93. Media exposure (ME), as a proxy for reputational capital, has an average of 25.16 times. For innovation activities (INN), the average number is 16.5, and the maximum and minimum values range from 247 to 0, indicating that there is a wide range among companies in terms of emphasis on research and development. Although the leverage of venturing activities (VEN) may reduce the risk of going IPO, the number of venturing activities only shows an average of 0.59, indicating that most Taiwanese start-ups do not emphasize venturing activities. Lack of venturing activities is likely a result of conservative management.

Table 2: Means, Standard Deviation, and Pearson Correlations between Variables

Variables	Mean	Standard Deviation	TED	TEDINS	TS	TEDH	TEDHB	PAT	ME	INN	VEN	VALUE	AGE
TED	5.45	0.501											
TEDINS	5.55	0.651	0.914***										
TS	9.36	3.447	-0.211	-0.243*									
TEDH	0.57	0.130	-0.146	-0.053	0.289**								
TEDHB	0.41	0.129	-0.345***	-0.212	0.011	0.289**							
PAT	3.93	5.706	0.096	0.066	0.153	-0.125	-0.128						
ME	25.16	30.713	0.381***	0.411***	0.065	0.030	-0.017	0.327**					
INN	16.50	41.629	0.253*	0.317**	0.069	-0.032	0.125	0.310**	0.712***				
VEN	0.59	0.937	0.015	0.036	0.161	-0.019	0.031	0.116	0.484***	0.422***			
VALUE	0.89	0.597	0.202	0.235*	-0.018	-0.253*	-0.140	0.046	0.372***	0.525***	0.433***		
AGE	5.63	2.155	-0.198	-0.181	-0.083	-0.123	0.211	-0.116	-0.027	0.026	0.222*		
GL	0.69	0.467	0.036	0.026	0.202	0.027	-0.280**	0.222*	0.082	0.119	-0.018	0.236*	0.299**

Note:
1. ***, ** and * denote correlation between variables significant at the 1%, 5% and 10% levels, respectively.
2. Total samples are 58.
3. Variables Definitions:
TED = The average educational level of the top management team. The scale is as follows: 1 for a primary education, 2 for a junior high school education, 3 for a senior high school education, 4 for a college degree, 5 for a university degree, 6 for a master degree and 7 for a doctoral degree.
TEDINS = The average educational level of the top management team in natural science.
TS = The size of top management team.
TEDH = The heterogeneity of the educational levels of the top management team.
TEDHB = The heterogeneity of the educational backgrounds of the top management team.
PAT = The number of patents that a firm owns prior to the IPO.
ME = The company's average three-year media exposures prior to the IPO.
INN = Innovation activities measured by the number of a company's patent applications over the two years following the IPO.
VEN = Venturing activities measured by the frequency of acquisitions, joint ventures and strategic alliances over the two years following the IPO.
VALUE = Corporate value measured by Tobin's q.
AGE = Years of corporation's establishment.

The correlation coefficient analysis shown in Table 2 reveals a high correlation (0.914) between the average educational level of the top management (TED) and the average educational level of the top management team in natural science (TEDINS). There is also a high correlation (0.712) between the number of news reports (ME) in the 3 years prior to the IPO and the average number of innovation activities (INN). We have used the variance inflation factor (VIF) to test the collinearity among the variables, and the result shows that there is no serious collinear problem. Since the top management teams of Taiwanese high-tech start-ups mostly have industrial expertise that includes natural science, the average educational level of the top management team (TED) is consequently approximate to the average educational level of the top management team in natural science (TEDINS). Thus, the two variables showed high VIF values (7.655 vs. 7.150). Other than TED and TEDINS, the VIF values of other variables are less than 5, indicating that they would not significantly confound our inference.

4.2 Relationship between Intellectual Capital and Entrepreneurship

Table 3 reports the effect of intellectual capital on innovation activities, venturing activities, and corporate value following the IPO. For innovation activities (INN), it is positively associated with the heterogeneity of the educational backgrounds of the top management team (TEDHB) at the 10% significant level. This result supports Hypothesis 1-1a, suggesting that top management team made up of experts with different backgrounds are more in tune with environmental changes, such as threats or opportunities, and better able to offer complementary, innovative and extensive views, thus the heterogeneity of team members are often able to elevate the concept of

innovation. This finding is consistent with the result reported by Hayton (2005). The relationship between the number of approved patents (PAT) and innovation activities (INN) is insignificant, demonstrating that the company's intellectual property rights do not have a significant impact on their innovation activities. Therefore, Hypothesis 1-1b is not supported. This is also consistent with Hayton's (2005) findings. The innovation activities (INN) is positively related to company's three-year media releases prior to the IPO (ME) at the 1% significant level. This result supports Hypothesis 1-1c, implying that media releases appear to reduce resource constraints, improve access to resources, and further influence companies' innovation activities. That is, accumulation of reputational capital can promote entrepreneurial activities.

Table 3: Effects of Intellectual Capital on Entrepreneurship and Corporate Value

$$INN_{i,t+1,t+2} = \beta_{10} + \beta_{11}TED_{i,t} + \beta_{12}TEDINS_{i,t} + \beta_{13}TS_{i,t} + \beta_{14}TEDH_{i,t} + \beta_{15}TEDHB_{i,t} + \beta_{16}PAT_{i,t} + \beta_{17}ME_{i,t} + \beta_{18}AGE_{i,t} + \beta_{19}GL_{i,t} + \varepsilon_{i,t+1,t+2}$$

$$VEN_{i,t+1,t+2} = \beta_{20} + \beta_{21}TED_{i,t} + \beta_{22}TEDINS_{i,t} + \beta_{23}TS_{i,t} + \beta_{24}TEDH_{i,t} + \beta_{25}TEDHB_{i,t} + \beta_{26}PAT_{i,t} + \beta_{27}ME_{i,t} + \beta_{28}AGE_{i,t} + \beta_{29}GL_{i,t} + \varepsilon_{i,t+1,t+2}$$

$$VALUE_{i,t+2} = \gamma_{10} + \gamma_{11}TED_{i,t} + \gamma_{12}TEDINS_{i,t} + \gamma_{13}TS_{i,t} + \gamma_{14}TEDH_{i,t} + \gamma_{15}TEDHB_{i,t} + \gamma_{16}PAT_{i,t} + \gamma_{17}ME_{i,t} + \gamma_{18}AGE_{i,t} + \gamma_{19}GL_{i,t} + \varepsilon_{i,t+2}$$

Independent Variables	Dependent Variables					
	INN		VEN		VALUE	
	beta weights coefficient	p-value	beta weights coefficient	p-value	beta weights coefficient	p-value
TED	-0.156	0.372	-0.163	0.328	-0.198	0.296
TEDINS	0.242	0.180	-0.001	0.893	0.301	0.187
TS	0.058	0.253	0.160	0.145	0.088	0.325
TEDH	-0.122	0.421	-0.088	0.356	-0.285**	0.034
TEDHB	0.203*	0.074	-0.023	0.676	-0.016	0.545
PAT	0.075	0.259	-0.099	0.247	-0.227*	0.058
ME	0.646***	0.000	0.592***	0.000	0.413***	0.003
AGE	0.022	0.185	0.107	0.206	0.228	0.143
GL	0.091	0.217	-0.107	0.194	0.169	0.186
F-Statistics	6.885***	0.000	2.333**	0.038	2.707**	0.029
Adjusted R ²	0.482		0.174		0.212	

Note:

1. ***, ** and * denote coefficients or F-Statistics significantly different from zero at the 1%, 5% and 10% levels, respectively.

2. Total samples are 58.

3. Variables definitions are the same as reporting in Table 2.

For venturing activities (VEN), results presented in Table 3 indicate that all representatives of human capital have no significant influence on venturing activities. Thus, Hypothesis 1-2a is not supported. Since the sample companies may be knowledge-intensive enterprises that focus on research and development activities, or be assembly-based manufacturing enterprises, their demand for research and development, product sales type and level of technicality are divergent. As a result, the effect of human capital of the top management team on venturing activities does not show significant association. As to the company's number of authorized patents prior to the IPO (PAT), it has no significant effect on venturing activities (VEN), thus, Hypothesis 1-2b is also not supported. Companies' three-year media releases prior to the IPO (ME) still have a significant association with venturing activities (VEN), which supports Hypothesis 1-2c and shows that accumulation of reputational capital indeed help to boost entrepreneurial activities.

Among the control variables, this study found that the age of the company (AGE) and the degree of globalization (GL) have a mostly positive but insignificant relationship with entrepreneurship. The results appear to indicate that these two factors will not affect the company's entrepreneurial activities to any great degree.

4.3 Relationship between Intellectual Capital and Corporate Value

As to the relationship between human capital and corporate value at the end of second year following the IPO, results in Table 3 report that only the heterogeneity of the educational levels of the top management team (TEDH) has a significantly negative impact on corporate value represented by Tobin's q-value at the 5% level. This finding appears to suggest that, the lower the heterogeneity of educational levels of the top management team, the smaller the communication barrier among team members is likely to be. The more efficient flow of communication allows the company to yield better financial performances, which in turn enhance corporate value. On the contrary, a greater heterogeneity of educational levels of the top management team will lengthen the decision-making time by requiring more time to communicate, and that is not beneficial to the organization's performance. Thus, Hypothesis 2a was partially supported. This finding is similar to the results of Pegels et al. (2000), but is inconsistent with the results of Goll et al. (2001) and Hambrick et al. (1996).

The intellectual property rights (PAT) has a significantly negative relationship with corporate value (VALUE) at the 10% level. This result is inconsistent with prior research (e.g., Bosworth and Rogers, 2001; Megna and Klock, 1993), possibly because owning large number of patents in the sample are held by a small number of companies, implying that the sample distribution could be skewed. In fact, the sample of 58 companies holds a total of 228 authorized patents; the top 10 companies hold 64.47% of them, and the top 3 companies hold 28%.

In addition, the reputational capital (ME) shows a significantly positive relationship with corporate value (VALUE) at the 1% level. This result supports Hypothesis 2c, which is consistent with other researches (e.g., Black et al., 1999; Dowling, 2006; Riahi-Belkaoui, 2003), suggesting that accumulation of reputational capital would enhance the corporate value.

4.4 Relationship between Entrepreneurship and Corporate Value

Table 4 presents the relationship between entrepreneurship and the corporate value at the end of second year following the IPO. As the table shown, both innovation activities (INN) and venturing activities (VEN) are positively associated with corporate value (VALUE) at the 1% and 5% levels, respectively. These findings are evidence that entrepreneurship has a positive effect on enhancing corporate value. Moreover, innovation activities have a greater effect on corporate value than does venturing activities, suggesting that investing in innovation activities yields more shareholders' benefits than does investing in venturing activities.

Table 4: Effects of Entrepreneurship on Corporate Value

$VALUE_{i,t+2} = \gamma_{20} + \gamma_{21}INN_{i,(t+1,t+2)} + \gamma_{22}VEN_{i,(t+1,t+2)} + \varepsilon_{i,t+2}$		
Variables	beta weights coefficient	p-value
INN	0.417***	0.001
VEN	0.257**	0.023
F-Statistics	13.542***	0.001
Adjusted R ²	0.306	

Note:

1. *** and ** denote coefficients or F-Statistics significantly different from zero at the 1%, 5% and 10% levels, respectively.
2. Total samples are 58.
3. Variables definitions are the same as reporting in Table 2.

4.5 Mediating Effect of Entrepreneurship

Table 5 reports the mediating effect of the regression analysis. First, based on Model 4-2's adjusted R square, the intellectual capital variables could explain 21.2% of the variation in corporate value. If entrepreneurship variables are taken into account, as shown in Model 4-4, the adjusted R square rises to 39.1% and increases 17.9% of explanatory power. While the F-Statistics of testing the increase in the power of explanation is 8.070, which is statistically significant at the 1% level. This evidence shows that the explanatory power on corporate value becomes more apparent when entrepreneurship variables are added in the model.

In terms of the human capital of the top management team, one variable of intellectual capital (TEDH in Model 4-2) and both variables of entrepreneurship (INN and VEN in Model 4-3) are significantly associated with corporate value (VALUE) from Table 5. This result meets second and third conditions verifying the mediating effect discussed in section 3.2.2. However, as shown in Table 3, the relationship between heterogeneity of the top management team's educational levels (TEDH) and entrepreneurship (INN and VEN) is not statistically significant, which suggests that entrepreneurship may have no mediating effect on the relationship between human capital and corporate value. Therefore, Hypothesis 4a is not verified.

As to intellectual property rights, the number of authorized patents (PAT in Model 4-2) up to the time of IPO has a significantly negative association with corporate value (VALUE). However, as Table 3 shows, there is no significant relationship between the number of authorized patents (PAT) up to the time of IPO and entrepreneurship (INN and VEN). Similarly, the mediating effect of entrepreneurship is not presented in the relationship between intellectual property rights and corporate value. Thus, Hypothesis 4b is also not verified.

Table 5: Testing of the Mediating Effect of Entrepreneurship

Model 4-2 : $VALUE_{i,t+2} = \gamma_{10} + \gamma_{11}TED_{i,t} + \gamma_{12}TEDINS_{i,t} + \gamma_{13}TS_{i,t} + \gamma_{14}TEDH_{i,t} + \gamma_{15}TEDHB_{i,t} + \gamma_{16}PAT_{i,t} + \gamma_{17}ME_{i,t} + \gamma_{18}AGE_{i,t} + \gamma_{19}GL_{i,t} + \varepsilon_{i,t+2}$ Model 4-3 : $VALUE_{i,t+2} = \gamma_{20} + \gamma_{21}INN_{i,t} + \gamma_{22}VEN_{i,t} + \varepsilon_{i,t+2}$ Model 4-4 : $VALUE_{i,t+2} = \omega_0 + \{\omega_1TED_{i,t} + \omega_2TEDINS_{i,t} + \omega_3TS_{i,t} + \omega_4TEDH_{i,t} + \omega_5TEDHB_{i,t} + \omega_6PAT_{i,t} + \omega_7ME_{i,t} + \omega_8AGE_{i,t} + \omega_9GL_{i,t}\} + \{\omega_{10}INN_{i,t} + \omega_{11}VEN_{i,t}\} + \varepsilon_{i,t+2}$						
Variables	Model 4-2		Model 4-3		Model 4-4	
	beta weights coefficient	p-value	beta weights coefficient	p-value	beta weights coefficient	p-value
TED	-0.198	0.725			-0.079	0.387
TEDINS	0.301	0.183			0.186	0.276
TS	0.088	0.260			0.016	0.631
TEDH	-0.285**	0.021			-0.203*	0.089
TEDHB	-0.016	0.491			-0.106	0.783
PAT	-0.227*	0.059			-0.235*	0.064
ME	0.413***	0.004			-0.058	0.370
INN			0.417***	0.001	0.475***	0.003
VEN			0.257**	0.018	0.277**	0.017
AGE	0.228	0.118			0.188	0.260
GL	0.169	0.126			0.156	0.302
F-Statistics	2.707**	0.041	13.542***	0.001	4.332***	0.009
Adjusted R ²	0.212		0.306		0.391	
F(ΔR ²)					8.070***	0.002
Note: 1. ***, ** and * denote coefficients or F-Statistics significantly different from zero at the 1%, 5% and 10% levels, respectively. 2. Total samples are 58. 3. Variables definitions are the same as reporting in Table 2.						

In regard to reputational capital, a company's average three-year media exposures prior to the IPO (ME in Model 4-2) shows significant relationship with corporate value (VALUE). Further, this variable (ME) also have a significant association with entrepreneurship (both INN and VEN), as shown in Table 3. After putting entrepreneurship variables (INN and VEN) into Model 4-4, the coefficient of reputational capital (ME) drops from 0.413 (significant at the 1% level) to -0.058 (insignificant). The regression coefficients of innovation activities (INN) and venturing activities (VEN) went up from 0.417 to 0.475, and 0.257 to 0.277, respectively. The results arising from this examination show that entrepreneurship does have a full mediating effect on the relationship between reputational capital and corporate value. Thus, Hypothesis 4c is supported and accumulated reputational capital contributes to enhance corporate value through the mediating effect of entrepreneurship.

4.6 Sensitivity Analysis

To strengthen the robustness of this study, we conducted tests for sensitivity. One test is to change the base period of the company's media release prior to the IPO. The other test is to change the scope of the high-tech company sampling.

Measuring the reputational capital has been done to calculate the average number of media exposures in the 3 years prior to the IPO (e.g., if the date of IPO is 10/1/2008, the base period goes to 10/1/2005). In our sensitivity analysis, the base period switches to the whole three years before the year prior to the IPO (e.g., if the date of the IPO is

10/1/2008, the base period is from 2005 to 2007). After newly measuring media releases, we re-run the regressions and the results are reported in Tables 6 and 7. Compared to the findings discussed above, the related results are roughly unchanged.

**Table 6: Effects of Intellectual capital on Entrepreneurship –
Change the Measuring Period of Media Releases**

Independent Variables	Dependent Variables			
	INN		VEN	
	beta weights coefficient	VIF	beta weights coefficient	VIF
TED	-0.212 (-0.798)	7.681	-0.215 (-0.647)	7.681
TEDINS	0.291 (1.138)	7.082	0.041 (0.128)	7.082
TS	0.085 (0.776)	1.312	0.184 (1.337)	1.312
TEDH	-0.120 (-1.096)	1.301	-0.086 (-0.631)	1.301
TEDHB	0.135 (1.151)	1.489	-0.088 (-0.599)	1.489
PAT	0.094 (0.874)	1.265	-0.084 (-0.624)	1.265
ME	0.642*** (5.612)	1.425	0.599*** (4.178)	1.425
AGE	0.041 (0.372)	1.352	0.126 (0.904)	1.352
GL	0.064 (0.585)	1.306	-0.132 (-0.963)	1.306
F-Statistics	6.748***		2.374**	
Adjusted R ²	0.476		0.178	

Note:

1. The numbers in parentheses are t-statistics. *** and ** denote coefficients or F-Statistics significantly different from zero at 1% and 5% levels, respectively.
2. Total samples are 58.
3. Variables definitions are the same as reporting in Table 2.

Littler and Sweeting (1990) and Hayton (2005) adopted the average research and development expenditures more than 5% of total sales in the 3 years prior to the IPO as a criterion to select sample companies. In our sensitivity analysis, we changed the selection criterion of firms' average research and development expenditures from 3% of total sales to 5% of total sales, resulting in a sample of 44 companies. We re-run the regressions and the results are presented in Tables 8 and 9. Compared to the findings discussed above, the

related results are roughly unchanged. The results arising from this analysis also indicate that entrepreneurship still shows a partial mediating effect on the relationship between reputational capital and corporate value. Overall, these results lending support to the argument that reputational capital in high-tech start-ups influences corporate value through the mediating effect of entrepreneurship.

Table 7: Testing of the Mediating Effect of Entrepreneurship – Change the Measuring Period of Media Releases

Variables	Model 4-2		Model 4-3		Model 4-4	
	beta weights coefficient	VIF	beta weights coefficient	VIF	beta weights coefficient	VIF
TED	-0.233 (-0.710)	7.681			-0.069 (-0.238)	7.829
TEDINS	0.334 (1.063)	7.082			0.182 (0.653)	7.273
TS	0.106 (0.780)	1.312			0.012 (0.101)	1.370
TEDH	-0.283** (-2.102)	1.301			-0.201* (-1.681)	1.340
TEDHB	-0.057 (-0.398)	1.489			-0.098 (-0.763)	1.548
PAT	-0.212 (-1.592)	1.265			-0.234* (-1.985)	1.300
ME	0.402*** (2.847)	1.425			-0.080 (-0.469)	2.709
INN			0.417*** (3.423)	1.216	0.486*** (3.095)	2.311
VEN			0.257** (2.110)	1.216	0.283** (2.256)	1.474
AGE	0.239* (1.742)	1.352			0.184 (1.516)	1.377
GL	0.153 (1.133)	1.306			0.159* (1.330)	1.345
F-Statistics	2.619**		13.542***		4.351***	
Adjusted R ²	0.204		0.306		0.393	
F(ΔR^2)					8.476***	

Note:

1. The numbers in parentheses are t-statistics. ***, ** and * denote coefficients or F-Statistics significantly different from zero at the 1%, 5% and 10% levels, respectively.
2. Total samples are 58.
3. Variables definitions are the same as reporting in Table 2.

**Table 8: Effects of Intellectual capital on Entrepreneurship –
Change the Sampling of High-Tech Firms**

Independent Variables	Dependent Variables			
	INN		VEN	
	beta weights coefficient	VIF	beta weights coefficient	VIF
TED	0.025 (0.135)	7.081	-0.131 (-0.364)	7.081
TEDINS	0.022 (0.126)	6.531	-0.106 (-0.309)	6.531
TS	0.068 (0.832)	1.408	0.160 (1.001)	1.408
TEDH	-0.132* (-1.699)	1.273	-0.113 (-0.740)	1.273
TEDHB	0.255*** (2.818)	1.738	0.089 (0.498)	1.738
PAT	-0.005 (-0.060)	1.299	-0.148 (-0.965)	1.299
ME	0.887*** (11.105)	1.351	0.647*** (4.130)	1.351
AGE	0.037 (0.453)	1.446	0.122 (0.754)	1.446
GL	0.043 (0.495)	1.631	-0.007 (-0.039)	1.631
F-Statistics	19.761***		2.338**	
Adjusted R ²	0.797		0.219	

Note:

1. The numbers in parentheses are t-statistics. *** and ** denote coefficients or F-Statistics significantly different from zero at the 1% and 5% levels, respectively.
2. Total samples are 44.
3. Variables definitions are the same as reporting in Table 2.

Table 9: Testing of the Mediating Effect of Entrepreneurship – Change the Sampling of High-Tech Firms

Variables	Model 4-2		Model 4-3		Model 4-4	
	beta weights coefficient	VIF	beta weights coefficient	VIF	beta weights coefficient	VIF
TED	-0.044 (-0.129)	7.081			-0.021 (-0.080)	7.115
TEDINS	0.177 (0.538)	6.531			0.194 (0.767)	6.554
TS	0.019 (0.127)	1.408			-0.103 (-0.863)	1.471
TEDH	-0.329** (-2.264)	1.273			-0.162 (-1.386)	1.393
TEDHB	0.068 (0.402)	1.738			-0.209 (-1.446)	2.147
PAT	-0.183 (-1.247)	1.299			-0.125 (-1.097)	1.335
ME	0.504*** (3.371)	1.351			-0.581** (-2.290)	6.608
INN			0.493*** (3.619)	1.371	0.962*** (3.883)	6299
VEN			0.262* (1.921)	1.371	0.354*** (2.839)	1.637
AGE	0.066 (0.426)	1.446			-0.014 (-0.116)	1.476
GL	0.264 (1.606)	1.631			0.225* (1.774)	1.643
F-Statistics	2.398**		16.473***		6.417***	
Adjusted R ²	0.289		0.418		0.581	
F(ΔR^2)					12.853***	

Note:

1. The numbers in parentheses are t-statistics. ***, ** and * denote coefficients or F-Statistics significantly different from zero at the 1%, 5% and 10% levels, respectively.
2. Total samples are 44.
3. Variables definitions are the same as reporting in Table 2.

CONCLUSION

Although previous studies have explored the relationship between two of intellectual capital, entrepreneurship, and corporate value, lack of empirical researches have examined simultaneously the relationship of all three elements. The purpose of this study is to understand the relationship among intellectual capital, entrepreneurship, and corporate value. The present research focuses on high-tech Taiwanese companies that issued an IPO between 1995 and 2002. In addition, the paper bases on a three-dimensional framework to divide intellectual capital into the human capital of the top management team, intellectual property rights, and reputational capital in order to explore the effect of intellectual capital on entrepreneurship and corporate value.

First, we find that human capital, especially the heterogeneity of educational backgrounds of the top management team, is positively affect innovation activities but not affecting venturing activities. That may be reasons that diversity of the top management team's educational backgrounds benefits the creation of new ideas but hinder to affect new venture. However, we find that the heterogeneity of educational levels of the top management team negatively affects corporate value. It suggests that, the lower the heterogeneity of educational levels of the top management team, the smaller the communication barrier among team members is likely to be. The more efficient flow of communication allows the company to yield better financial performances, which in turn enhance corporate value.

Second, the reputational capital, especially a company's media exposures, shows positive influence on firm's entrepreneurship (innovation activities and venturing activities) and on firm's value. As the findings to reputational capital, it implies that accumulation of reputational capital will enhance the corporate value.

Third, our analysis shows that entrepreneurship has a positive impact on enhancing corporate value. Moreover, innovation activities have a greater effect on corporate value than does venturing activities, suggesting that investing in innovation activities yields more shareholders' benefits than does investing in venturing activities.

Finally, we provide evidence that reputational capital, through the mediating effect of entrepreneurship, has a positive impact on corporate value. Since the electronic industry in Taiwan is marked by intense competition and rapid changes, both innovation activities and venturing activities indeed contribute to the development of new products or entrance into new markets, resulting in more media releases that accumulate reputational capital and increase the value of the company. Future research may extend the scope to other industries and justify the essentiality of intellectual capital for a company's survival.

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