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創新資本的價格效果：策略性定位與策略性競爭之調節效果

Price Effect of Innovation Capital in IPO Market: The Moderating Effects of Strategic Positioning and Strategic Competition



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策略性定位與策略性競爭之調節效果

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The Moderating Effects of Strategic Positioning

and Strategic Competition

本論文係 黃瓊誼 君 (R95741001) 在國立臺灣大學商學研究所完成之碩士學位論文，於民國 97 年 5 月 26 日承下列考試委員審查通過及口試及格，特此證明

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摘要

過去許多研究顯示創新活動的投入與公司長期的績效、成長密不可分，然而卻也有眾多研究發現，在初級市場中，公司有較多的研發投入可能致使其上市價格受到低估，因此本研究分別從資源基礎理論及資訊不對稱理論兩個不同的觀點，嘗試瞭解：(1) 創新資本（包含研發密度及專利總數）投入與公司初次公開發行價格之關係、(2) 公司對自身之策略定位與上市價格之關係，及(3) 對手的策略性競爭與公司上市價格之關係。本研究主要蒐集在 1986-2006 年間上市的美國製造業公司，並從 SDC、Datastream 及 USPTO 資料庫蒐集相關資料，最終總樣本數為 117 家。

研究顯示：創新資本與公司初次上市價格之間的關係並不明顯，但若加入公司策略性定位之變數，則研發密度與公司上市價格是否被低估之間的關係變得清楚，若公司傾向於為產業領導者，則所易於有較多的突破性創新，進而緩和價格低估的現象；另一方面，加入策略性競爭之因素，則會使專利總數與價格低估間的關係變得更加嚴重，即考量競爭對手的策略性回應後，公司即便擁有較多的專利，仍無法改變上市價格被低估的現象。

關鍵字：初次公開發行、創新資本、策略性定位、策略性競爭、資訊不對稱、

資源基礎觀點

Abstract

Innovation capital including R&D intensity and patent stocks has assumed a key source of competitive advantages and can create firm long-term growth. However, some researches indicate, innovation capital is associated with increased underpricing in initial public offerings (IPOs). This study based on two different perspectives- resource-based theory and information asymmetry theory to investigate (1) the relationship between innovation capital and the underpricing of IPOs. (2) the role which strategic positioning plays in the IPO market and (3) how strategic competition influences a firm's IPO price. This study is based on a review of 117 U.S. manufacturing firms that issued IPOs from 1986 to 2006. The information was gathered from SDC、CRSP and USPTO databases.

The result of this study shows that the relationship between innovation capital and underpricing in IPO is mixed. However, strategic positioning can mitigate the relationship between R&D intensity and underpricing. It means firms introducing more breakthrough innovations to be market leaders can avoid their IPO prices being underpriced although their R&D intensity is high. Besides, strategic competition makes the relationship between patent stocks and underpricing worsen. Having many patents does not ensure firms' earnings and the actual value of a firm's in innovation is relative to other firms' reaction in innovation.

Keywords: initial public offering, innovation capital, strategic positioning, strategic competition, information asymmetry, resource based view.

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Chapter 1 Introduction

As regard firms' IPO prices over the past 20 years, there is substantial evidence showing that IPOs are underpriced on average. Underpricing of initial public offering means the initial offered price is lower than the closing price at the end of the first day of trading. Namely, firms lose additional gains that would have been received on the offering price (Ritter, 1998). In the 1980s, the average level of underpricing was 7.4 percent; that rose to 14.77 percent in the period in 1990–98; and in 1999–2000, it averaged an astounding 65 percent (Loughran & Ritter, 2004). Therefore, it's important to understand the factors driving underpricing and why firms are willing to sell shares to the investment community at the prices which are lower than market price.

Despite of various explanations for the underpricing phenomena, the findings thus far are inconsistent and inconclusive. Some researchers argue that underpricing may be a result of firm size (e.g., Ibbotson, Sindelar, & Ritter, 1988), or age (e.g., Megginson & Weiss, 1991; Mikkelsen, Partch, & Shah, 1997; Ritter, 1991). Others look to the upper levels of company and say the level of CEO equity (Certo, Daily, Cannella, & Dalton, 2003), as well as whether the CEO is also the founder, are critical factors in IPO pricing.

One of the more enduring explanations is Rock's (1986) notion that information asymmetry is strongly rooted in innovation capital. Some studies based on information asymmetry find that innovation capital is associated with increased underpricing in the IPO market because the value of a firm's innovation activities is not easy to determine beforehand and requires investors' access to detailed confidential knowledge (Heeley, Matusic and Jain, 2007).

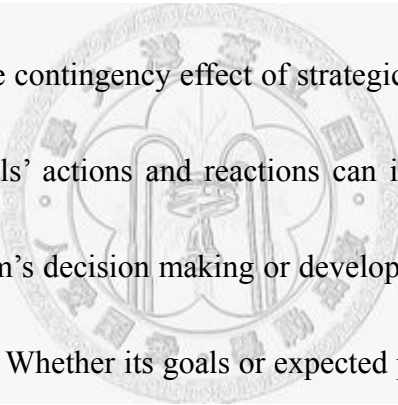
However, according to resource-based theory, the role of innovation in creating firm growth has long been recognized. Firms invest in innovation activity in hopes of developing innovative products/services to survive, create profit and grow. A positive relationship between innovation and firm value has been strongly supported in previous research (e.g., Griliches, 1981; Pakes, 1985) and the return from investing in innovation may yield a 200 percent over the long run (Griliches, 1981).

This argument, the positive relationship between innovation capital and underpricing in the IPO market, presents a dilemma: RBV traditionally argues that both intangible and tangible resources determine firm performance. However, in the context of primary market for a firm's initial public offering (IPO), information asymmetry between company insiders and investors may affect the perceived value of a firm's resources to outsiders and their decisions to buy/sell the shares at hand. Firms investing in innova-

tion may result in a discounted price in the IPO price in the stock market.

The purpose of this research is to untangle this dilemma by examining the relationship between innovation capital and a firm's value in IPO markets, and empirically inquire whether information asymmetry is the critical reason resulting in underpricing in the primary market and whether resource-based theory can be used to explain the phenomena in IPO market or not. This study further analyzes the effects of different strategic positioning on IPO prices because different kinds of strategic positioning may signal different values, different resources and capabilities or create different information asymmetry problems for investors. Previous literature (e.g., Forbes, and Wield, 2000) mentioned that technology leaders may be prone to introduce more radical innovations. If firms want to be market leaders, they may tend to do more breakthrough innovation. In contrast, if firms want to be market followers, they may be prone to do more incremental innovation. Investors can evaluate their market position by reviewing what they did prior to their IPO. If a new business enters the IPO market without a clear position and investors only have ambiguous images to them, these firms will try to establish themselves as either market leaders or followers by undertaking different kinds of innovation. Introduction of radical innovation or incremental innovation may be interpreted as signaling different growth or earning potential and different strategic posi-

tion may also make investors adjusted their expectation to firms. Previous research (such as Phene, Fladmoe-lindquist and Marsh, 2006; Zhou, Yim and Tse; 2005) has highlighted the important of breakthrough innovation and its effect on a firm's long-term performance. Some studies also indicated technology leaders may tend to do radical innovations (Forbes and Wield, 2000). This study extends to investigate the role of strategic positioning plays in IPOs to know how strategic positioning affects a firm's IPO price.



This study also tests the contingency effect of strategic competition because industrial characteristics and rivals' actions and reactions can influence a firm's profit and investors' evaluations. A firm's decision making or development plans cannot only consider its ability or resources. Whether its goals or expected profit can be realized greatly depend on competitors' responses: That is, whether they accommodate or fight. Therefore researchers such as Daft (1988) and Duncan (1972) have indicated that environment affects the organizational process and decision making. This study also analyzes the effect of strategic competition on outsiders' reactions to test the influence of environment to IPO prices.

With the empirical results from a sample of 117 IPOs of manufacturing firms during 1986-2006, this study aims to investigate (1) the relationship between innovation

capital and the underpricing of IPOs. Innovation capital includes R&D intensity and patent stock. This study also uses contingency models to explore the effects of strategic positioning and strategic competition on underpricing in IPOs in order to understand (2) the roles which strategic positioning play in the IPO market and (3) how strategic competition influences a firm's IPO price.

This study is structured as follows. Chapter 1 is an introduction and guide to this study. Research objectives of this study are developed based on the research background and motivation. Chapter 2 provides literature reviews of information asymmetry and resource-based theory, firm's R&D activity, strategic position, and strategic competition. The major subjects discussed include definition of each variable, and hypotheses are developed regarding the relationships between innovation activity and firm's underpricing in IPO. The main effects that R&D intensity is positively related to underpricing in IPO and patent stock is negative related to and underpricing in IPO are moderated by strategic positioning and strategic competition. Chapter 3 proposes research framework of this study. The research model is developed based on the literature review and research objectives of this study. In this chapter, it also provides the research design and methodology of this study. Research design, sampling plan, model operating, data collection, and statistical analysis are presented. Chapter 4 presents the statistical analysis

results of this study. Findings of this study are discussed in this chapter. Finally, chapter 5 provides conclusions and suggestions of this study.

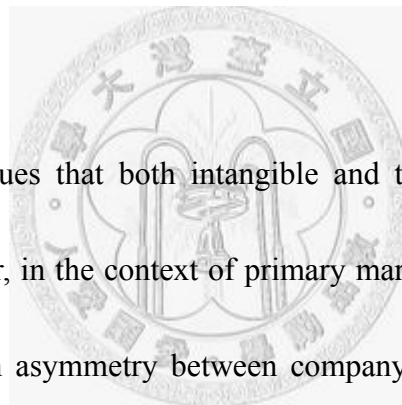


Chapter 2 Literature Review and Hypotheses

Many new entrepreneurs and existing companies wish to attract funds to develop their business ideas. From resource-based view, if one firm can show or present its ability of innovation through issuing many patents, investors may appreciate its development and value. However, according to information asymmetry, matching funds to business opportunities is complex, although both investors and entrepreneurs like to do business together (Healy and Palepu, 2001).

Wernerfelt (1984) built resource-based theory around the internal competencies of firms. The theory relies on two key points. First, resources are the determinants of firm performance (Barney, 1991; Schulze, 1992). Resources are inputs into the production process and capabilities are ability to coordinate and deploy resources to perform tasks. Second, resources must be rare, valuable, difficult to imitate and non-substitutable by other rare resources (Selznick, 1957; Snow and Hrebiniak, 1980; Teece et al, 1992). Resources may be tangible (e.g., equipment, finance) or intangible (e.g., brand name, trade secrets) and capabilities may consist of subroutines and master routines (e.g., product development, distribution) that integrate subroutines into performance (Nelson and Winter, 1982; Grant, 1991). The resource-based view (RBV) of the firm (Penrose,

1959; Wernerfeldt, 1984; Barney, 1991; Schulze, 1992) posits that a firm's internal processes create a resource bundle which can become the means of creating and sustaining competitive advantages. These competitive advantages are important to superior performance (Bharadwaj et.al., 1993). According to previous research (e.g., Capron et al., 1998), resources which are valuable, rare, inimitable and non-substitutable (VRIO) reflect not only a firm's ability to design new products or process technologies, but also its market presence vis-à-vis competitors (Craif and Douglas 1996; Cooper, 2000).

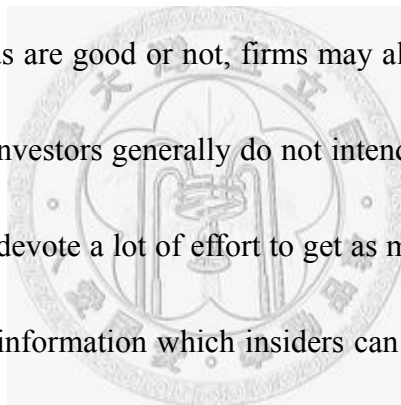


RBV traditionally argues that both intangible and tangible resources determine firm performance. However, in the context of primary market for a firm's initial public offering (IPO), information asymmetry between company insiders and investors may affect the perceived value of a firm's resources to outsiders and their decisions to buy/sell the shares at hand. There is substantial evidence that on average, initial public offering are underpriced. Underpricing of initial public offering means the initial offering price is lower than the closing price at the end of the first day of trading. Namely, the value of firm's share is sold at the price which is lower than firm's actual market value, then an offering price is underpriced, firm has "left money on the table"; that is, they have lost additional gains that would have been received on the offering price (Rit-

ter, 1998). In recently year, pricing in the IPO market has received increasing attention of researches and some researchers indicate that information asymmetry with respect to the value of the firm is especially strong between IPO issuers and potential investors. In the 1980s, the average level of underpricing was 7.4 percent; it rose to 14.77 percent in the period 1990–98; and in 1999–2000, it averaged an astounding 65 percent (Loughran & Ritter, 2004).

Information asymmetry is thought to promote unwillingness to trade and increase the cost of capital as investors “price protect” against potential losses from trading with better informed market participants (Bhattacharya and Spiegel, 1991). Why information asymmetry problem happens and result in the difficulty of investors to know the real value of a firm? One reason is “adverse selection problems”, hesitation of firms about the optimal amount they should disclosure (Healy and Palepu, 2001). Several recent analytical papers have examined the impact of public disclosure of information on information asymmetry (e.g. Morse and Ushman, 1983; Venkatesh and Chiang, 1986; Anthony, 1987; Daley, Hughes, and Raybum, 1991; Lee, Mucklow, and Ready, 1993; Hagerman and Healy, 1992; Greenstein and Sami, 1994 and Welker, 1995) and found that information asymmetries arise because the disclosure information is selected by firms and some firm-specific information exists but has not been disclosed

publicly. This with-held information may be privately available to corporate insiders¹ and let them enjoy information advantage. The adverse selection problems (moral hazard problems) are one kind of agency problems. Entrepreneurs typically have more information about the actual value of investment opportunities and incentives to overstate their value to attract investors to support their ideas. If investors unable to distinguish between good and bad projects, they may be cheated by firms' claims of new opportunities, products or innovation and suffer from lemon problems (Akerlof, 1970), because no matter the ideas are good or not, firms may always declare that their ideas are valuable. In addition, investors generally do not intend to play active roles in management, so they may not devote a lot of effort to get as much information as possible. In the end, the amount of information which insiders can gain and which outsider can access may be dramatically different and information asymmetry problems become more serious (Jensen and Meckling, 1976). Consequently, the information asymmetry of firm is considered high (low) when entrepreneurs of the firm have relatively large (small) amount of firm-specific information.



¹ Corporate insiders include officers, directors and owners (according to the definition of Security and Exchange Act in 934) who gain more specific source of information, insiders have more proxies to evaluate the value, operation, profit and importance of projects, innovations or new products (Stoll, 1978).

The second reason of information asymmetry is the extent of complex of the information. Investors may not possess the skills required to evaluate the value of firm's projects because they may not be experts in any sector or domain (Welker, 1995; Misha, Heide and Cort, 1998 and Dierkens, 2001) In addition, the amount of new ideas increases, so does the amount of information necessary for investors to effectively evaluate all of these efforts within firms (Heeley, Matusic and Jain, 2007). Accounting rule is the third reason for information asymmetry. The real firm value may be not reflected on the balance sheet. For example, according to generally accepted accounting principles (GAAP)'s conservatism rules, innovation investments are typically unrecognized on the balance sheet as assets in spite of the obvious importance for the firm's future growth (e.g. Barth et al., 2001; Aboody and Lev, 2000; and Barron et al., 2002; Anandarajan et al., 2000). Therefore, when investors evaluate the value of innovation by referring to accounting reports, they will easily tend to underestimate firms value.

All corporate investments create information asymmetries because entrepreneurs or managers can continually observe changes in investment productivity on an individual asset basis but outsiders only get highly aggregated information on investment productivity at discrete points of time, companies only disclosure part of information or investors don't have enough relative information. However, according to Aboody and

Lev's research (2000) the extent of information asymmetry associated with R&D is larger than that associated with tangible and financial investments because the latter results or outcomes are easily to be observed and accessed. For example, if pharmaceutical company's new drug fails to pass Phase I clinical test, company may not be willing to share the events to outsiders. However, a downturn phenomenon in commercial market is easily to be noticed.

Many studies have examined various factors which may influence the price in the IPO market, including items such as firm size (e.g., Ibbotson, Sindelar, & Ritter, 1988), firm age (e.g., Megginson & Weiss, 1991; Mikkelsen, Partch, & Shah, 1997; Ritter, 1991), whether the CEO is also the founder (Certo, Covin, Daily, & Dalton, 2001), level of CEO equity (Certo, Daily, Cannella, & Dalton, 2003). Although various explanations for the underpricing phenomenon have been discussed (Certo et al., 2001), Rock (1986) argues that information asymmetries about issuing firms' value is critical problem for underpricing.

Even through previous studies based on resource-based theory indicate that firms having more resources and capabilities can have better performance, firms may still underprice IPOs to induce investors without full information to participate in the IPO market. Thus, an increase (decrease) in the level of information asymmetry may lead to

a commensurate increase (decrease) in the amount of underpricing because firms know more about product attributes or potential value of innovation than investors to judge the value of innovation activities than outsiders (Aboody and Lev, 2000) and the effect of information asymmetry seem to affect the firm value form resource and capability endowment.

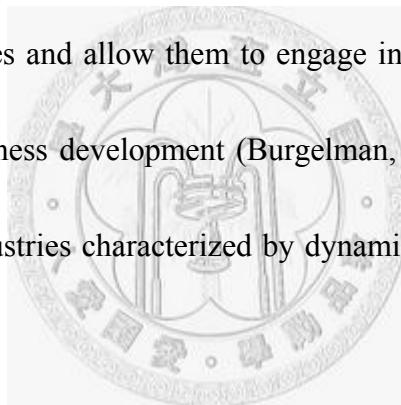
In this study, this study examines the relationship between firm innovation activities and IPO underpricing, based on the resource-based theory and information asymmetries theory. This study tries to know how the positive relationship between resource, capability and firm performance will be affect by information asymmetries, and the relationship between innovation activities and value in the IPO market because even through innovation is a way for firms to present their resources and capabilities, it is an inherently uncertain process and its impact on firm value is only realized in the future. It is hard for retail market participants (e.g., uninformed investors) to evaluate the value of innovating firms. In contrast, insiders of firms will have superior information about the potential value of the firms' innovation efforts.

2-1 Innovation Activities of Firm

About what is innovation or innovation activity and what isn't, some researchers define that innovation include creative and risk-taking behavior such as introducing new goods or new methods of production. Others think that innovation also include undertaking activities in different ways to what is known to the firms and initiatives such as improving products or procedures (Cummings, 1998). This study, this study defines innovation broadly, which is ability to provide significant advances in productivity and create functionalities not previous available (Chen et al., 2006). But why many researchers pay highly attention to innovation?

From the beginning of the industrial revolution, innovation has been a key source of competitive advantage. Introducing new products can help firms protect their margin, whereas, investing in process innovation can help firms lower their costs (Schilling, 2008). That is why many researchers have emphasized the important of innovation. And research evidence has identified a range of benefits for companies which are able to exploit innovation strategies to gain higher profit and market share (Narver and Slater, 1990; Copper, 1993; Pawar et al., 1994; Calantone et al., 1995; Griffin, 1997; Han et al., 1998). Therefore, in spite of many problems of shaping and managing it, innovation has become imperative for many companies (Prajogo and Ahmed, 2006).

Innovation can be further divided into two groups: incremental (continuous) or breakthrough (discontinuous), depending on their “newness”. Incremental innovations refer to minor changes in technology, simple product improvements, or line extensions that minimally improve the existing performance. In contrast, breakthrough innovations are novel, unique, or state-of-the-art technological advances in a product category that significantly alter the consumption patterns of a market (Wind and Mahajan, 1997). Because breakthrough innovation enable firms to challenge the existing technological order, shape new trajectories and allow them to engage in corporate reinvention, business growth, and new business development (Burgelman, 1983) breakthrough innovation is vital to firms in industries characterized by dynamic and complex technological environments.



Even though researchers realize the important of innovation for firms, how to measure innovation is another issue. In many previous studies, researchers use R&D intensity to measure innovation orientation (Freeman, 1974) because numerous studies indicate a significant relationship among innovation, R&D activities, and investment in organizations (Capon, etal, 1992; Baldwin and Johnson, 1996; Koen and Kohli, 1998). Harryson (1997) also argue innovative companies are often characterized by their excellent R&D activities.

However, R&D intensity is only an input for the innovation process, it only represents the amount of research and development effort a firm is undertaking and is an indicator of the level of firm innovation activities (Heeley, Matusik and Jain, 2007). As Pegels and Thirumurthy's (1996) argument, R&D intensity contributes to an increase in knowledge and innovation, but not every R&D experiment succeeds in generating a patent or product. Consequently, R&D may provide more information about the magnitude of the ex-ante uncertainty rather than the value of the innovation output. For this reason, Pakes et al. (1998) indicates that patents constitute a valuable measurement of innovation (see also Geroski, 1994; Pakes et al., 1998; Balkin et al., 2000). Patent is output (albeit an intermediate one) of research and an additional indicator of firm innovation activities. Part of the process of securing a patent is disclosure to the public of both the grant action and information about the invention (Heeley, Matusic and Jain, 2007). The signal model (Allen and Faulhaber, 1989) also argues that the more R&D investments and patent stock a firm has, the more innovative the firm is. And the Chen's study in 2006 also confirmed the appropriate that both R&D intensity and patent stock can be used as signaling devices. Based on previous literature, this study takes R&D intensity and patent stocks of firms as two proxies to surrogate for innovation.

According to the predictions of signaling models, in that the magnitude of innova-

tion capital (including R&D intensity and patent stock) can be also used to signal the quality of a firm's investment projects and thereby its ability to generate future cash flows. Stock prices are also estimable based on the discounted value of the expected future cash flows to be generated by the assets. From resource-based perspective, either tangible or intangible assets are expected to generate positive future cash flows (e.g., Chauvin and Hirschey, 1993) and determine organizational performance (e.g., Penrose, 1959; Wernerfelt, 1984; Prahalad and Hamel, 1990).

However, how much money investors want to fund depends on how much the value of project they realize. But as this study has mentioned before, R&D activity differs from other capital and financial inputs (e.g., property, plant, and equipment, inventory or project financing) along several important dimensions related to information asymmetry. First, many R&D projects, such as software programs are unique to the developing firm, whereas most capital investments share common characteristics across firms within an industry. And mostly, the price of physical and financial assets traded in organized markets conveys information about asset productivity and value, but there are no organized markets and, thus, no asset prices from which to derive information (Aboddy and Lev, 2000).

Second, research projects are usually treated as confidentiality (Bah and Dumo-

nitier, 2001). Therefore, insider may gain substantially larger amount of firm-specific information in R&D intensive firms than in firms without R&D, so the effect of information asymmetry may show up especially in firms with more R&D activities (Aboody and Lev, 2000). In other words, insiders are better able to judge the value in R&D-intensive firms.

In addition, the recognition of R&D intensity and patent stocks on financial statement under current generally accepted accounting principles (GAAP) also make information asymmetry problems (Ritter and Welch, 2002). Under current GAAP, innovation investments are typically unrecognized in the balance sheet as accounting assets despite their obvious importance for the firm's future growth. The reason of the argument for non-recognition of R&D intensity and the limited recognition of patents are echoed with "uncertainty" based on the principle of conservatism.

Therefore, even through R&D activities let investors know firms' resource endowment and the accumulation of resource and capabilities, when determining the value of innovation activity of a particular firm in special context, IPO market, investors requires access to detailed confidential information of that firm and special knowledge of specific technological domain. But investors cannot access this information. This study hypothesizes that:

Hypothesis 1-1: R&D intensity of firm is positively related to its underpricing in IPOs.

The problem of information asymmetry also emerges from the evolution of patent stocks. The most critical reason is that investors lack special knowledge of specific investing objects. According to the patent law, the information disclosed is technical and only sufficient to enable someone who is “skilled in the art” to replicate the invention. But the information of patents disclosed by firms provides little information about the ability of the innovating firm for investors to extract value from the invention, because most of (even all of) investors are not the experts in any technical sector. According to the concepts of innovation funnel, most innovative ideas do not become successful new products. Many studies suggest (e.g. Griffin, 1997) that only one out of several thousand ideas results in a successful new product: many projects do not result in technically feasible products; others may fail to earn a commercial return.

However, patent stock may deliver a signal to investors that firms have more growth potential because they have more abilities and resources to create new products or innovation. As the patent stock increase, even through issuing patents is not equal to introducing new products, firms have more chances to make or translate patents into new product if firms have many patents. Even through the quantity of patents also has

information asymmetry problem and ensure to be translated into many successful new products, the signal effect of patent stocks may make investors adjust their evaluation of firms or make them will to fund more money to firms because the firms may have high probability to successfully create new products and earn more profit in the future. Thus, this study hypothesizes that:

Hypothesis 1-2: Patent stock of firm is negatively related to its underpricing in IPOs.

2-2 Strategic Positioning of Firm

Innovation is the generation and/or acceptance of ideas processes, products or services (Garcia and Calatone, 2002). Depending on their “newness”, innovation can be incremental (continuous) or breakthrough (discontinuous). Incremental innovations mean minor changes in technology or simple product improvements. In contrast, breakthrough innovations are novel, unique or state-of-the-art technological advances that significantly alter the consumption patterns of a market or technological trajectory (Wind and Mahajan, 1997).

Many researchers (such as Phene, Fladmoe-lindquist and Marsh, 2006; Zhou, Yim and Tse; 2005) emphasize the importance of radical innovation for firms because it

enables firms to challenge or change the existing technological order, improve customer benefits. (Benner and Tushman, 2003; Chandy and Tellis, 1998; Tushman and Anderson, 1986), and allow firms to engage in corporate reinvention, business growth, and new business development (Burgelman, 1983). But who may be more likely to do radical innovation?

Technology leaders are those which collectively define the technological frontier at any point in time, and move it forward. Successful innovation of technology leader requires first, a commercially correct definition of the new frontier, and send, the activities involved in reaching it. In contrast, technology followers usually approach the frontier through the transfer of technology leaders (Forbes and Wield, 2000). According to Katz and Shapiro' research (2001), the industry leaders will tend to develop breakthrough innovations in order to strengthen their market position and earn monopoly rents (Etro, 2004).

The image of being technological or industrial leader is valuable reputation to a firm. Reputation is a proxies or signals for investor or reviewer to make rational assumptions about the intentions and firms' future behaviors (Krep and Spence, 1985; Fombrun and Shanley, 1990). In turn, signals are valid when they are derived form past observations and serve as a stable basis to form rational beliefs (Wilson, 1985). Thus,

reputation presumes a tight coupling between past actions and future expectations and organizational attributes and the evaluation of organizations (Weigelt and Camerer, 1988). Firms may try to integrate their resources and abilities to do innovation to shape their own reputation in order to establish themselves as either market leaders or followers. If they position themselves as technological or industrial leaders, they may undertake more radical innovation because radical innovation is novel, unique or state-of-the-art technological advances and may help firms to dominant new markets.

However, radical innovations are highly risky to pursue because developing state-of-the-art technology is very expensive and requires substantial investment (Sorescu, Chandy and Prabhu, 2003; Wind and Mahajan, 1997). What firms' characteristics drive their willingness to do risky activities and to introduce breakthroughs?

According to Zhou, Yim and Tse's study, this study could start form the strategic orientation and market force to answer this question. The former represents inside out perspective and suggests that a firm's competitive advantage results form its unique assets and capabilities (Barney, 1991; Wernerfelt, 1984) On the other hand, the market force reflects an outside-in view and argues that external market forces the development of competitive advantage (Porter, 1980, 1985).

From the resource-based view, strategic orientation reflects the firm's philosophy of its own values and beliefs that guide the firms to achieve superior performance (Gaignon and Xuereb, 1997). These values and beliefs are intangible and are difficult to trade, imitate or duplicate, so that they may shape firm's competitive advantage (Day, 1994; Hunt and Morgan, 1995). According to Zhou, Yim and Tse's study, strategic orientation includes three types: market, technology and entrepreneurial orientation. First, market orientation highly emphasizes the profitable creation and maintenance of superior customer value (Naver and Slater, 1990). Some researcher suggest that market orientation is essentially customer orientation (Deshpande, Farley and, Webster, 1993), representing the concept of customer pull in a firms strategic planning (Day, 1994). Because market-orientated firms highly concern customers, they are good at its ability to seek and use market information to create and deliver superior customer value (Slater and Narver, 1999). Then, they may lead to the discovery of new solutions to unexpressed needs to customers (Slater and Narver, 1998; Thomke and Sonnack, 1999).

Second, technology orientation represents the philosophy of technological push, which supposes consumers prefer technologically superior products and services (Gaignon and Xuereb, 1997; Wind and Mahajan, 1997). Therefore, technology-orientated firms highly commit to R&D, pay attention to access new technologies, and the applica-

tion of the latest technology (Gatignon and Xuereb, 1997).

The third type is entrepreneurial orientation. It represents a firm's preference to pursuit of new opportunities in new markets or existing areas (Hult and Ketchen, 2001).

In addition, it also emphasizes the soul of creating new business is often reached through the introduction of breakthrough innovations (Lumpkin and Dess, 1996). With risk-taking nature, an entrepreneurial firm willing to invest the necessary resources to opportunities that may result in costly failures (Naman and Slevin, 1993).

On the other hand, market force can divided into two fundamental characteristics to urge firm to do radical innovation: demand uncertainty and technological turbulence (Zhou, Yim and Tse, 2005). Demand uncertainty is the instability of consumer preference and expectation. In unstable markets, consumers' preference may change quickly and identification of consumers' preference is difficult. In such market, incremental innovation is unlikely to satisfy them (Wind and Mahajan, 1997), so companies could turn to do breakthrough innovation in order to provide offering that precede customer need.

Technological turbulence refers to the rate or speed of technological advances within industries. Fast technological advances significantly shorten the life cycle of existing products, skills or innovations. It may also erode the competitive advantage of

even well-entrenched firms (Porter, 1985; Tushman and Anderson, 1986). In the industries with rapid change in technology, firms must promote breakthrough innovation.

But even though firms realize the importance of breakthrough innovation and will to undertake it, how to shape radical skills, products or innovation is another issue. Early researches on innovation (Allen and Cohen, 1969; Mueller, 1966) demonstrate that external sources of knowledge are vital to major products and process innovations. More recently, Lorenzoni and Lipparini's (1999) study reveals that the firm's ability to coordinate competencies and combine knowledge across corporate boundaries influences its growth and innovativeness. These arguments suggest that if a firm wants to increase its ability to create innovations it must look to external sources of knowledge. Powell, Koput and Smith-Doerr (1996) also stated that in the biotechnology industry, with its regime of rapid technological development, no single firms have all the internal capabilities for success in innovation. Similarly, Shan and Song (1997) also argued that firms in industries with rapid technology changes will find their competitive advantages erode if they only depend on internal knowledge. Therefore, Firms should learn external knowledge to overcome competency traps (Levitt and March, 1988; Levinthal and March, 1993) that limit the firm's ability to access and build on new paradigms. In short, external knowledge may make or help firms to overcome competency orders that limit the firm's ability to access and shape on new trajectories (Levitt and March, 1988; Le-

cinhal and March, 1993).

Preceding literatures have discussed how radical innovation forms and highlighted how risky they are and how important they are. Some researches also indicate technology leaders may be likely to develop breakthrough innovations. Then, this study extends to know the effect strategic positioning of new firms.

From resource-based view, if a new business enters the IPO market without a clear position and investors only have ambiguous images to them, these firms will try to integrate their own resources or abilities to intrude innovations to show their abilities, resource or growth potential in order to shape reputation or image to investors. They will try to establish themselves as either market leaders or followers by undertaking different kinds of innovation. If one firm tends to do more radical innovation, their resources or abilities may be a big impression on audiences because radical innovation is novel, unique or state-of-the-art technological advances and a firm should devote many efforts including resources and abilities to create breakthrough innovation.

Form the information-asymmetry view, firms position themselves as leaders may signal that they hope to lead markets and earn monopoly rents. In stock market, industrial leaders may have better market prices such as Yahoo (Chin, Lee and Kleinman, 2006). If one firm announce that they are or want to be market leaders, investors can confirm whether a firm's behaviors are consistent with what their announcements. Even

through most firms in IPO markets are new businesses and investors have limited information to evaluate their value, investors still can decide whether to believe firms' announcement or not by reviewing firm's behaviors which they did prior to their IPO. If firms who introduce more radical innovations, investors may be prone to believe that they want to be market leaders. Because of the signal effects of radical innovation and strategic positioning which hint the developmental project of firm has potential value and may bring much profit, investors may also appreciate the value in breakthrough innovation, even through information asymmetry problems still happen.

Both theories (RBV and information asymmetry) presume that as innovation capital increase, the potential value of radical innovation makes firm's growth potential become more apparently and attractively. Therefore, this study hypothesizes that:

Hypothesis 2-1: Technological positioning of firm negatively moderates the relationship between R&D intensity and IPO underpricing: Among firms with stronger technological leadership, the higher the level of R&D intensity, the less likely IPO underpricing is to occur.

Hypothesis 2-2: Technological positioning of firm negatively moderates the relationship between patent stock and IPO underpricing: Among firms with stronger technological leadership, the higher the level of R&D intensity, the less likely IPO underpricing is to occur

2-3 Strategic Competition

The environment creates both opportunities and problems for organizations. Firms relying on the environment for scarce resource and must deal with and adapt to changes in the environment (Pfeffer and Salancik, 1978). Some researchers such as Daft (1988) and Duncan (1972) have indicated the environment affects organizational process and decision making probably more than other factors. And many studies have also proven environmental factors influence the success or failure of innovation development (e.g., Cooper, 1994; Montoya-Weiss and Calantone, 1994; Rothwell, 1992).

However, the effect of environment isn't static. It is related to the interaction between rivals. Therefore, many researchers (such as Jovanovic, 1992; Lippman and Rumelt, 1982; Frank, 1988; Jovanovic and Lach, 1989) pay attention to the strategic competition among firms. Schelling (1960) defines what the meaning of strategic here is as follow: "If the essence of a game of strategy is the dependence of each person's proper choice of action in what he expects the other to do. It may be useful to define a strategic move as follow: A strategic move is one that influences the other person's choice, in a manner favorable to one's self, by affecting the other person's expectations of how one self will behave." This definition highlight that the essence of rivalry is a striving by firms for potentially incompatible positions (Caves, 1984; Scherer & Ross, 1990): Firms

feel the effect of each other's moves and are prone to respond them (Porter, 1980, 1988). In short, individual profit levels crucially depend on the exit and output decisions of rivals. Based on the definition of strategic competition, this study can realize the relationship among innovation, competition and firms' performance.

From resource based perspective, firms with identical resource requirements (identical market domains) are perfect competitors. At the other, firms with distinct resource requirements (distinct market domains) do not compete at all. Thus, the more similar the resource requirements of a focal firm to those of other firms, the greater the intensity of competition it is likely to experience. However, the level of competition is different in different markets. Market structure, market size or market' life cycle may also influence competition (Besanko, Dranove, Shanley and Schaefer, 2004). If firms issue new patents or new products and their competitors also do so immediately, firms and their competitors may have similar resource or the growth potential of the market is limited. When evaluating the value of innovation in these firms, investors may take the market to be in a state of flux, and monopoly rents may quickly succumb to new sources of competition, so they may hesitate to invest this kind of firms (Grant, 1996).

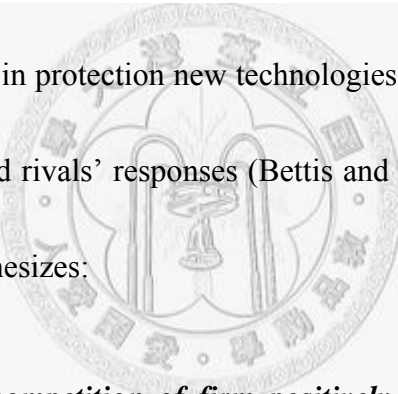
From information asymmetry perspective, when a firm announces new product, technology or patents in particular technological sectors or patent class, it signals to the

market and competitors that it creates more opportunities for differentiation or shape new competitive advantages and market share (Chaney et al., 1991; Kleinschmidt and cooper, 1991). The increase of earning and market share would positively influence firm's share price. However, the actual effect is according to how its competitors response to the announcement (Bulow et al., 1985; Sundaram et al., 1996). If the rivals accommodate the announcers by staying out, then the expected impact on the announcers' earnings and firm values will be positive and that on the rivals' will be negative. On the other hand, if competitors respond to the announcers' innovation or patent launches by adopting a matching strategy, then the impact on the announcers' profits would decrease (Chen, Ho, Ik and Lee, 2002). The nature of competitive interaction in an industry should affect individual firms' share-price response to the announcement of new strategic initiatives. When one firm announces a patent and its rivals respond to the announcement seriously and quickly, the value of patent may be decrease. In contrast, their rival accommodate the announcement, the value of patent may be increase.

For investors, rivals' reactions may signal the value of patents and can help them to evaluate the profit the patent may bring. An innovation introduced in a highly competitive market may not contribute to firm's profit as much as if it were introduced in a market dominated by the innovating firm because their rivals may introduce similar

even better innovations to markets immediately (Lerner index, cf. Cozarrin, 2001). Therefore, if one firm issues a patent in a technological domain which isn't highly competitive, it may signal for its stakeholders and shareholder that they may capture monopoly rent.

In short, both theories (RBV and information asymmetry) argue the impact of innovation on the performance of the firm depends on or is influenced by environment faced by the firm. Patent is not only an innovation output but also a protection for firm. The effectiveness of patents in protection new technologies or the potential profit of patents varies by industries and rivals' responses (Bettis and Hitt, 1995). Based on above statements, this study hypothesizes:



Hypothesis 3-1: Strategic competition of firm positively moderates the relationship between R&D intensity and IPO underpricing: Among firms subject to stronger strategic competition, the higher the level of R&D intensity, the more likely IPO underpricing is to occur.

Hypothesis 3-2: Strategic competition of firm positively moderates the relationship between patent stock and IPO underpricing: Among firms subject to stronger strategic competition, the higher the level of patent stock, the more likely IPO underpricing is to occur..

2-4 Subconclusion

In traditional markets, according to resource-based view, competitive advantages are rooted inside a firm's assets that are valuable and inimitable. A firm's capabilities or competencies and management abilities marshal these assets to produce superior performance (Penrose, 1959; Wenerfelt, 1984; Prahalad and Hamel, 1990). Generally, innovation capital is thought as resource and it may increase firms' performance. However, In IPO markets, according to information asymmetry theory, corporate insiders may enjoy information advantages which may be resulted from the hesitation of firms about the optimal amount they should disclose, the investors' lack of specific knowledge for technological regions. Thus, in order to avoid potential losses from trading with better informed market participants, investors may do "price protect" and firm's IPO price may be undervalued. The underpricing may be more serious in firms' R&D activities than capital and financial investments. R&D activity differs from other capital and financial inputs because each firm's projects are unique and firm usually treat their developmental plans as confidentiality (Bah and Dumonitier, 2001) so information which outsider can gain become more less. Besides, there are no organized markets, thus, no asset prices to derive information (Aboody and Lev, 2000). Investors may be hard to evaluate the actual value of firms' ideas and may easily tend to underestimate the value

of firms' innovation activities because of the recognition of innovation activities according to principles of conservatism in accounting reports.

The purpose of this research is to study this dilemma of the relationship between innovation capital and IPO price by examining the relationship between innovation capital and a firm's value in IPO markets, and also test that whether information asymmetry is the critical reason resulted in underpricing and whether resource-based theory can be used to explain the phenomena in IPO markets.

Besides, breakthrough innovation has the potential to create markets, shape consumers' preferences, and change consumers' basic behaviors and the positive relationship between breakthrough innovation and firms' performance has been proven. Market leaders may be prone to invest more resources to development radical innovation. However, few researches study the effect of introducing breakthrough innovation or strategic positioning on investors and on IPO prices. Whether the introduction of radical innovation or announcing to being market leaders will be a positive signal to outsiders is an interesting and important question. Therefore this study further analyzes the effects of strategic positioning on IPO prices to understand what the role of strategic positioning plays in IPO markets.

This study also tests the contingency effect of strategic competition because industrial characteristics and rivals' actions and reactions can influence a firm's profit and investors' evaluations. Strategic competition and strategic interaction between firms and their rivals may signal the potential rent innovations may bring to investors. Based on previous results which have proven that environment and competition affects the organizational process and decision making (Daft,1988; Duncan, 1972). Therefore, this study extends to analyze how strategic interactions affect the investors' evaluation of firms and firms' IPO prices to test the influence of strategic competition in IPO markets.

In short, this study tries to test the relationship between innovation activities and underpricing in IPO market according to the information asymmetry and resource-based theory and further confirm the signal effects of strategic positioning and strategic competition. this study hopes that this study extend many previous literatures which focus on the impact of innovation activities, strategic positioning and strategic interaction on firms long-run performance into explain how these factors influence the investors' judgments of firms and firms' IPO price.

Chapter 3 Research Design and Methodology

This chapter first introduces the sample and data collection, than brings up construct measurement of each research construct, including underpricing in IPO, R&D intensity, patent stock, strategic positioning, strategic competition and control variables. Then the hypotheses are tested and the conceptual model of this study is presented.

3-1 Sample and Data Collection

To empirically examine possible relationship between the innovation capital and the effect of underpricing in IPO and consider the strategic positioning and strategic competition at the same time, the study is based on a review U.S. manufacturing firms (SIC code: 29-39) that issued IPOs from 1986 to 2006.

Base on the research context, this study obtained data from several sources. This study used the Securities Data Corporation (SDC) database to identify firms in U.S. manufacturing industries which conducted initial public offering in the period of 1986-2006. First-day trading information for the samples was obtained from the Center for Research in Security Prices (CRSP) tapes. Patent data forms 1986 to 2006 were obtained from the U.S. Patent and Trademark Office (USPTO) database, which provides the issue date and assignee information for each utility patent². Firm assets, sales, and

² A utility patent may be granted to anyone who invents or discovers and new and use-

R&D expenditure in the year prior to the IPOs were obtained from Datastream database.

This study collected about 4200 IPOs of U.S. manufacturing firms during 1986 to 2006. This study deleted firms with (1) incomplete information including lacks of IPO price or close prices on the first trading date or reference of patents (2) no patents which were issued in five years prior to its IPO (62% populations had filed for at least one patent in the five years prior to their IPO). The final samples consisted of 117 firms from 26 industries.



ful process, machine, article of manufacture, compositions or matter, or and new useful improvement thereof. (U.S. patent & Trademark Office Web site)

Table 3- 1 Number of sample firms

			Sum(N=117)
Industry			
1.	2515	Mattresses, Foundations, and Convertible Beds	1
2.	2653	Corrugated and Solid Fiber Boxes	1
3.	2834	Pharmaceutical Preparations	12
4.	2836	Biological Products, Except Diagnostic Substances	15
5.	2860	Industrial organic chemicals	2
6.	2869	Industrial Organic Chemicals, Not Elsewhere Classified	1
7.	3482	Small Arms Ammunition	1
8.	3536	Overhead Traveling Cranes, Hoists, and Monorail Systems	1
9.	3554	Paper Industries Machinery	1
10.	3571	Electronic Computers	43
11.	3572	Computer Storage Devices	2
12.	3577	Computer Peripheral Equipment, Not Elsewhere Classified	1
13.	3589	Service Industry Machinery, Not Elsewhere Classified	1
14.	3621	Motors and Generators	1
15.	3629	Electrical Industrial Apparatus, Not Elsewhere Classified	1
16.	3661	Telephone and Telegraph Apparatus	1
17.	3663	Radio and Television Broadcasting and Communications Equipment	1
18.	3674	Semiconductors and Related Devices	16
19.	3679	Electronic Components, Not Elsewhere Classified	3
20.	3691	Storage Batteries	1
21.	3714	Motor Vehicle Parts and Accessories	3
22.	3825	Instruments for Measuring and Testing of Electricity and Electrical	1
23.	3841	Surgical and Medical Instruments and Apparatus	1
24.	3845	Electro medical and Electrotherapeutic Apparatus	4
25.	3851	Ophthalmic Goods	1
26.	3931	Musical Instruments	1

3-2 The Conceptual Framework

According to the discussion in chapter2, the factors can be classified into four main groups, as figure 3-1 shows. In this research this study is curious about the interrelationships among R&D intensity, patent stock and underpricing in IPO. This study also aims to examine the moderating effects of the strategic positioning and strategic competition. For the purpose of this study, this study developed the conceptual framework as shown in figure 3-1. As a result, this study develops 6 hypotheses that are derived from four main dimensions and the detailed accounts of the hypotheses are given below.

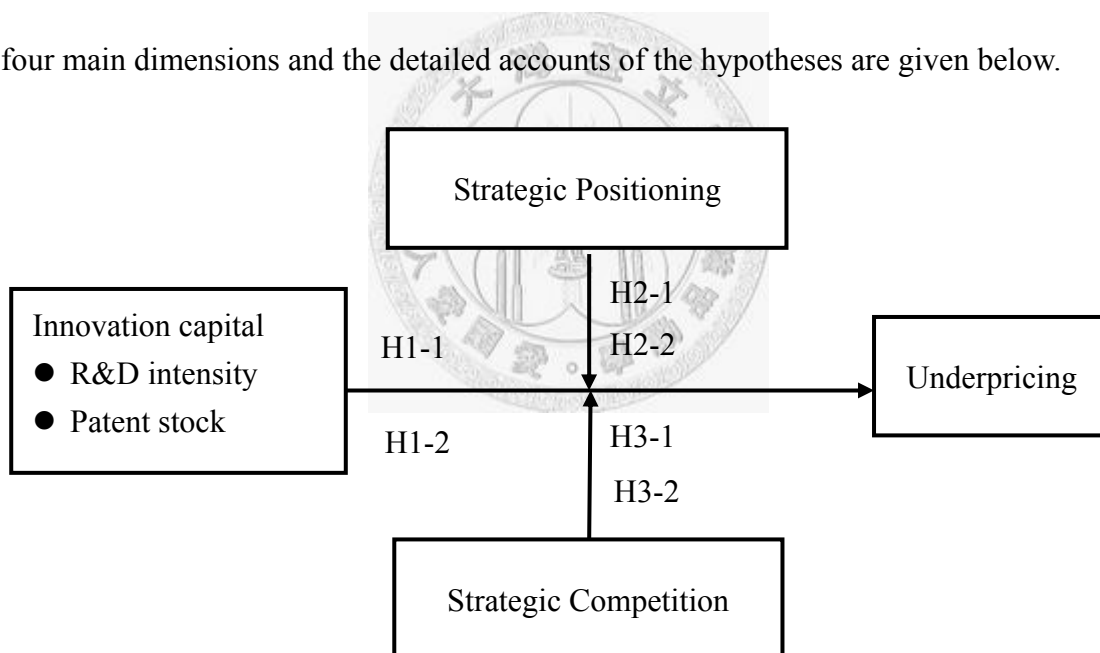


Figure 3- 1. Conceptual Framework

Base on the literature reviewed in the previous chapter, the six hypotheses, as listed in Chapter 2, are formulated and will be evaluated through empirical validation in this study.

3-3 Measurement

Secondary data were used to construct measures for the R&D intensity, patent stock, the effect of underpricing in IPO, the strategic positioning and strategic competition as follow.

3-3-1 Under price in IPOs

Referring to the definition of underpricing, it is measured by the first-day stock return. This study calculated the price changed in stock market during the first day of trading for an IPO, which is calculated as follows. If the result is positive, it means firms' value is underpricing, vice versa.

$$\text{First-day stock return} = \text{closing price} - \text{offer price}$$

3-3-2 R&D intensity

Because of the ambiguous relationships between innovation and underpricing in IPO, this study used R&D intensity and patent stock to evaluate the relationship between them. The use of R&D intensity follows from the study suggesting that R&D investments are associated with increased underpricing in the IPO markets (Guo, Lev and Shi, 2005) and it is measured as follows.

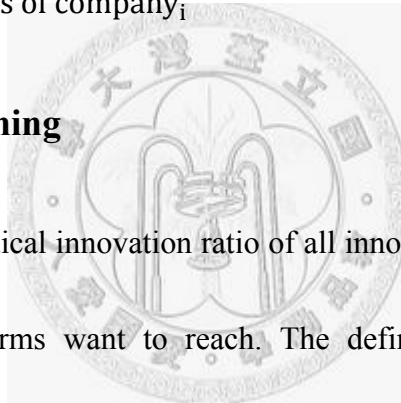
$$\text{R\&D intensity}_i = \frac{(\text{R\&D expenditures})}{\text{Asset}}$$

Because firms' sales may change dramatically, this study uses asset as denominator to measure R&D intensity in order to avoid R&D intensity highly altering.

3-3-3 Patent stock

Patent stock is measured by summing the number of patents that a firm had in the five years prior to its IPO because recent patents provides the most current information about firm inventive activities at the time of IPO.

Patent stock = $\sum_{i=1}^{117}$ patents of company_i



3-3-4 Strategic Positioning

This study uses the radical innovation ratio of all innovation of a firm's to evaluate what strategic positions firms want to reach. The definition of radical innovation represents the border technological root of the underlying knowledge or research related to the patents, the higher is the originality of a patent. Therefore, the strategic positioning can be calculated as follows where k is technological sector (Trajtenberg et al, 1997).

$$\text{Strategic positioning} = 1 - \sum_{j=1}^{N_i} \left(\frac{\text{number of citations made by patent } i \text{ to patents which belong to patent class } j}{\text{total number of citations made by patent } i} \right)^2$$

Firms tend to be market leaders may have high scores, vice versa.

3-3-5 Strategic Competition

Strategic competition is used to represent the competitive condition in the industries. Therefore, it can be measured by calculating the time interval difference between one firm's patent issue date and the other firm's patent issue date in the same regime. The fewer days the time interval is, the more serious competition is. Strategic competition could be measured as bellow.

$$\text{The level of competition} = \sum_{i=1}^{117} \sum_{j=1}^{117} \sum_{k=1}^n \left(\frac{\text{Time interval difference between the issue date of the firm}_i\text{'s patent in class}_j \text{ and issue date of the other firm}_j\text{'s patent in class}_k}{\text{total patents of the firm}_i} \right) (i \neq j)$$

3-3-5 Control variable

A number of other economic factors may also influence the prices in IPO (Baysinger and Hoskisson, 1989). Consequently, empirical analysis must be conducted within the context of a well-specified model of the underpricing in IPO. This study summarized current and past research conclusions on the economic determinants of the prices of IPOs and defined firm sizes, the time interval between firms founded and IPO, decade dummy, industry dummy, and Internet boom dummy as control variables for the empirical tests in this study.

(1) Firm size

It was important to account for firm size to insure that our patent stock measure reflected the innovation output of a firm and not firm size because industrial organization researches have revealed that highly capitalized corporations absolutely have higher level of R&D intensity, vice versa (Scherer, 1990). Moreover, even among large firms, the largest will enjoy the greatest economies of scale in R&D (Rothwell, 1984) To control for the effect of *firm size*, this study included firm size by the natural (ln) of the total sales in the year prior to IPO (Ibbotson, Sindelar, & Ritter, 1988).

(2) Firm age

In general, more public information is available about the value of the older firms which can reduce information asymmetries. This reduction in asymmetry suggests that there will be a negative relationship between the difference years between firm age and underpricing. To control this effect, this study logged firm age prior to IPO (Megginson & Weiss, 1991; Mikkelson, Partch, & Shah, 1997; Ritter, 1991).

(3) Decade dummy

To account for the potential difference of economic environment, this study sets decade dummy and divided samples into two groups, before 2000s and after 2000s be-

cause most of our samples founded in 1990s and 2000s, only few of them founded in 1980s.

(4) Internet bubble dummy

Because of the internet boom happened from 2nd quarter in 2000 to 3rd quarter in 2002, environmental condition is highly dynamic and chaotic. To account for this effect, this study uses internet boom dummy and divided our samples into three groups. Some of them founded before Internet boom, some of them founded at that time, and the others founded after that time (Heeley, Matusic and Jain, 2007).

(5) Industry dummy

Previous research has shown that the optimal level of R&D investments made by a firm depends partly on industrial environment, which is the firm's market demands (e.g., Hambrick & MacMillan, 1985; Inkpen & Long, 1981). Therefore, industry may affect R&D spending.

(6) Technology dummy

Firms operate in different fields with different extent of their basic scientific knowledge. The greater this knowledge, the more efficient will be the conversion of R&D inputs into outputs. To insure that any firm-level effects were not due to technology differenc-

es, this study included technology dummies and divided samples into three groups low technology, stable low technology, or high technology, using Chandler's (1994) industry classifications.

3-4 Statistic Method

The main statistics tool for this study is the software of Statistics Package for Social Science (SPSS) to test those previous hypotheses and to see what the information is revealed. The testified processes are organized as follow.

3-4-1. Descriptive Statistics Analysis

The thesis studies the relationship between innovation capital and the underpricing in IPO with the descriptive statistical method for presenting and characterizing data.

From this, this study summarizes and describes numerical information from the data in order to know the properties frequency, and percentage of each variable.

3-4-2. Correlation Analysis

The strength of a relationship between variables is usually measured by the method of correlation analysis.

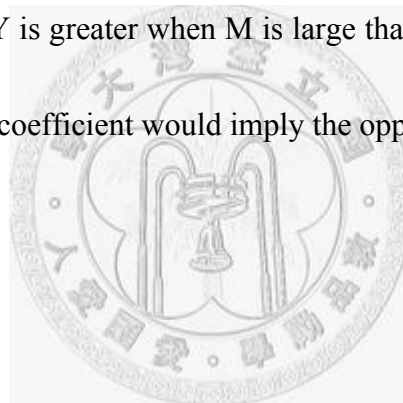
3-4-3. Moderated Hierarchical Logistic Regression Analysis

For a better understanding of the relationships between all the variables, multiple logistic regressions analysis is used to verify the relationships between innovation capital and the underpricing in IPO and other variables including the strategic positioning and strategic competition. Then, according to Schoonhoven (1981) and Darrow and Kahl (1982), moderated hierarchical regression analysis is an appropriate technique for testing hypothesized contingency relationships since it allows interaction terms, which are implied in all contingency relationships, to be directly examined. In moderated regression analysis, the statistical significance of interaction effects is tested by regressing the dependent variable on two main variables (one is the R&D intensity, the other is the patent stock) and the interaction effect of these main variables (Sharma, Durand & Cur-Arie, 1981). The form of the moderated regression equation employed in this research was

$$\ln \frac{p}{1-p} = f(x) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 M_1 + \beta_4 M_2 + \beta_5 X_1 * M_1 + \beta_6 X_1 * M_2 + \beta_7 X_2 * M_1 + \beta_8 X_2 * M_2 + \varepsilon$$

where Y is the dependent variable (the underpricing in IPO); X₁ is the first independent variable (R&D intensity) and X₂ is the second independent variable (Patent stock); M₁ is the first moderator variable (strategic positioning) and M₂ is the second moderator variable (strategic competition); X₁ * M₁ is the interaction

between R&D intensity and strategic positioning, $X_1 * M_2$ is the interaction between R&D intensity and strategic competition, $X_2 * M_1$ is the interaction between patent stock and strategic positioning and $X_2 * M_2$ is the interaction between patent stock and strategic competition. P is probability. If the addition of the interaction term significantly increases the power of the regression equation to explain the variance in the dependent variable, then an interaction or contingency effect can be said to exist. Furthermore, a positive and significant interaction term coefficient would imply that the positive influence of X on Y is greater when M is large than M is small. A negative and significant interaction term coefficient would imply the opposite.



Chapter 4 Analysis and Results

The association between R&D intensity, patent stock, and underpricing which is moderated by strategic positioning and strategic competition, are going to be investigated in this chapter. This study is going to find out what the relationship is between dependent and independent variables. This chapter will be divided into two parts.

The first section is the descriptive analysis of the data including the characteristics of the data set, and the results of the measurement variables. Then follows the correlation analysis of each variable in order to see whether there is highly correlated relation or not. It is bound to check the degree and direction of association between two variables.

The second section is the moderated hierarchical logistic regression analysis of the R&D intensity, patent stock and underpricing. In this part, this study will find out what is the relationship between the dependent variable and independent variables and the weight of each variable. Then, this study adds strategic positioning and environmental. Finally, the hypotheses mentioned in chapter three are going to be examined.

4-1 Descriptive Statistics and Correlation Analysis

Table 4-1 shows summary statistics for the variables used in the estimations and

reports interactions among key study variables. The intercorrelations among the full set of independent variables were sufficiently low to preclude the problem of unstable coefficients in the regression procedures.

4-2 Logistic Regression Results

To test the hypothesis, this study used moderated hierarchical logistic regression analysis. For each hypothesis, this approach allowed us to regress underpricing against a set of control variables and then add R&D intensity and patent stock into the equation and the test. The control variables include employee, size, years between founded and IPO, Internet bubble dummy, decade dummy, technology dummy and industrial dummy.

For each hypothesis, this study completed a separate hierarchical logistic regression as shown in Table 4-2. The hierarchical logistic regression involved four steps. In step one, this study regressed on control variables. In step two, whether firm IPO price is underpriced or not was regressed on the control variables and the dimension of firms' R&D intensity and patent stock associated with the hypotheses. The Chi-square test constituted the test of hypothesis. In step three, this study adds moderators including strategic positioning and strategic competition into model. In step four a moderated hierarchical logistic regression was utilized. For two-way interaction,

control variables were entered into the regression first, and then the R&D intensity and patent stock were entered, followed by strategic positioning and strategic competition being analyzed. Then, the logistic regression equation was calculated by using the interaction terms.

Table 4-2 reports the results of hypothesis test. It presents the major result from the study, which supports some hypotheses. The four regression equation was significant and the accuracy of models is between 84.6% and 90.6%.

As shown in model 2 (Table 4-2), Hypothesis 1-1 and 1-2 were not supported. For the firms in our sample, the relationship between R&D intensity and stock return, and patent stock and stock return are mixed. However, Hypothesis 2-1, which suggested when firms try to be market leader by introducing original innovation, the relationship between R&D intensity and underpricing was negative is supported ($\beta=-101.005$, $p<0.05$) as model 4 shows but the result did not support Hypothesis 2-2, which suggest a firm's strategic positioning positively moderate the relationship between patent stock and underpricing in IPO.

Testing Hypothesis 3-1, which suggested serious competition in particular regime could positively moderate the relationship between R&D intensity and underpricing, was accomplished by examining model 4 but was not supported. However,

Hypothesis 3-2, which suggested serious competition in particular regime could enhance the negative relationship between patent stock and underpricing, was supported ($\beta=7.045$, $p<0.01$) (Table 4-2).

In the cases, the regression equations including interaction terms explained significantly more variance than the equations without these variables used to test hypothesis 1-1 and 1-2. For overall models, the accuracy of model for Model 4 (90.6%) was higher than Model 2 (87.2%).



Table 4- 1 Person's Correlation Coefficients among the study's variable (n=117)

	Means	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
1. Underpricing	0.787	-	1.000											
2. Firm ages (ln)	1.070	0.460	0	1.000										
3. At Internet bubble dummy	0.270	-	0.691	-	1.000									
4. After Internet bubble dummy	0.377	-	0.042*	-	-	1.000								
5. Decade dummy	0.650	-	0.053	-	-	-	1.000							
6. High technology dummy	0.918	-	0.582	-	-	-	-	1.000						
7. Low technology dummy	0.049	-	0.243	-	-	-	-	-	1.000					
8. Sales (ln)	4.770	1.140	0.157	0.312***	-	-	-	-	-	1.000				
9. R&D intensity (ln)	1.000	0.150	0.054	-0.213*	-	-	-	-	-	0.248**	1.000			
10. Patent stock (ln)	1.030	0.560	-0.046	-0.050	-	-	-	-	-	0.054	-0.046	1.000		
11. Strategic positioning	0.430	0.230	0.154	0.045	-	-	-	-	-	0.089	0.154	0.307	1.000	
12. Strategic competition (ln)	-1.100	0.800	0.160	-0.014	-	-	-	-	-	0.019	0.160	0.364	0.065	1.000

¹: * p<0.05; ** p<0.01; ***p<0.001

² Because of the limit of the space, this study can't show the correlation coefficients among listed variables and industrial control variables. But there are not highly correlation between listed variables and industrial control variable.

Table 4- 2 Regression Result for Underpricing in IPOs

Control Variables		Model 1	Model 2	Model 3	Model 4
		β	β	β	β
Firm ages (ln)		0.444	0.907	0.966	3.754
At Internet boom dummy		-0.539	-0.298	-0.460	-3.389
After Internet boom dummy		-0.365	-0.036	-0.250	-0.333
Decade dummy		1.129	1.391	1.322	2.963*
High technology dummy		-17.948	-18.001	-17.403	-11.335
Low technology dummy		-0.945	-0.594	-0.490	3.096
Firm size (ln)		0.122	0.370	0.243	0.957
Industry dummy ³		-	-		
Universal					
R&D intensity (ln)	H1-1		7.467	7.142	68.761
Patent stock (ln)	H1-2		-0.588	-0.524	6.231*
Strategic position (SP)				2.118	19.159
Strategic competition (SC) (ln)				-0.158	-0.935*
Contingency					
R&D intensity x SP	H2-1				-101.005*
Patent Stock x SP	H2-2				-1.976
R&D intensity x SC	H3-1				14.128
Patent stock x SC	H3-2				7.045**
Chi-square		43.827	46.531	48.664	72.334*
Estimate of model fit		84.6%	87.2%	84.6%	90.6%
-2 Log likelihood		66.297	63.593	61.460	37.790

Note: * p<0.05; ** p<0.01; ***p<0.001

³ Because of the limit of the space, this study can't show the β among listed variables and industrial control variables. But there are not highly relationship between listed variables and industrial control variable.

Chapter 5 Conclusions and Suggestions

This study, drawing on resource-based and information asymmetry theory, is aimed to examine how value creation activities, such as the pursuit of innovation, affect the IPO performance in the primary market. Given the elusive causality between a firm's intellectual capital and the perceived value in the marketplace, the study also tests the moderating effects of a firm's strategic positioning and the level of strategic competition. The empirical analyses provided several results which advance our knowledge of the effect of innovation capital (including R&D intensity and granted patents) on a firm's IPO underpricing.

First, this study tested Hypothesis 1-1 and 1-2: The relationship between R&D intensity and underpricing, and granted patents and underpricing. However, their relationships are mixed. That is, either resource-based theory or information asymmetry theory may not fully explain the relationship between innovation capital and underpricing. Possible reasons for this may be due to ignorance of the impact of firms' ability on long-term performance in information asymmetry and the variety of information channels such as news or announcement of forming strategic alliance.

Some previous studies (such as Allen and Faulhaber, 1989; Hirschey and Richard-

son, 2001 and Lanjouw and Schankerman, 2004) have proven the positive relationship between innovation capital and firms' long-term performance according to resource-based view. For example, in Lanjouw and Schankerman's study, they supplement the empirical evidence by employing the market-to-book value. Their results also show the influence of innovation capital on firms' performance. According to their empirical research, this study can conclude that a firm's effort and outcomes in innovation are evidence of their unique abilities and resources, and may act as indicators of competitive advantage and growth potential. When investors evaluate whether to fund a company, they may not only be influenced by information asymmetry but also be compelled to take firms' achievements or efforts into consideration. This may cause investors to adjust their evaluation of firms and influence IPO prices. Information asymmetry theory may not take into account the influence of firms' unique abilities or resources have over investors' assessments of firms, but instead focus more on how a lack of information may put investors at a disadvantage.

This study did not consider the variety of channels through which firms can deliver value to investors. This study only assumes that investors gain information from official sources such as financial reports and patent certificates because other sources like news, announcements of strategic alliances and advertisements are hard to evaluate. However,

there are many forms of news and advertisements, and each of them may deliver different content to investors. There are also many types of strategic alliances: some firms may form partnerships with famous companies, some of them may cooperate with small companies. Therefore, it's difficult to set a standard to evaluate these channels' effects on the performance of various firms. However, some event studies indicate that announcements of positive news, events or activities may gain higher than usual returns because of signal effects (e.g. Kelm et al, 1995; Narayanan et. al., 2000). Signaling theory argues that investors respond to management communications about ongoing activities of the firm (Alchian and Demetz, 1972; Jensen and Meckling, 1976; Littler, 2006). In addition, firms can show how rich their resources and abilities are through many channels to adjust shareholders' expectations about a firm's future performance (Narayanan et al., 2000). In short, when managers deliver some special or positive information to outsiders that communicate their intention to undertake value-adding activities, shareholders may change their expectations. For example, forming a strategic alliance with a well-known partner to conduct of R&D activities may raise the probability of success (Danzon et al., 2005). Investors hearing this announcement may assume that the firm will soon earn a big profit. Therefore, even though most of the value of an alliance is appropriated by larger firms at the outset of many alliances, small firms experience increases in share price

(Alvarez and Barney, 2001).

In the second stage of this study, this study developed a theoretical basis for the moderating effect of strategic positioning on the underpricing of IPOs. Adding this dimension -strategic positioning- makes the relationship between innovation capital and underpricing clear, which supports hypothesis 2-1 but not hypothesis 2-2. This means that when firms make efforts to come up with breakthrough innovation, investors in IPO markets may interpret this development as a signal of potential profitability in the future and tend to believe the announcements of its strategic position. However, the effects are much clearer on R&D intensity than patent stocks. Reasons for this may be related to whether the innovation activities are obvious. Because of information asymmetry problems and cannot gain many specific details about a company's innovation activities. They may try to find a similar firm as a reference point to help them estimate the value of a firm's innovation activity. However, if the innovation activity is unclear, investors may find it is difficult to find an appropriate reference. R&D intensity is the input of innovation activity. It may be hard for outsiders to know exactly what R&D investment will lead to, or the intention of R&D plans. Therefore, it is very difficult for investors to find a firm as reference firms. They may be easily influenced by signals from the firms' history. For example, if firms announce that they want to be market leaders and in the past, the firms

introduced many breakthrough innovations, investors may be prone to believe the firms may become or want to be market leaders and appreciate the value of their innovation activities because their innovation let outsiders know how rich their resource and abilities are. If a firm has obvious innovation results, like patents, the relative information carried by patents may help investors to find reference points in their research. Then, investors may not only care about what the innovation is but also compare one firm's innovation with another's. Whether firms introduce radical innovations may not be a big influence on investors' judgments of firms and investors may be not easily believe whether the firms are market leaders or not only by tracing what they did prior to IPO. When evaluating a firm's value, investors may be more easily affected by whether a firm's innovation activities seem better than a competitor's, but less influenced by the specifics of a firm's innovation. Even if investors can't understand the utility of patents and information asymmetry problems still exist, innovation outcomes of firms may give investors more information to evaluate their value. Therefore, the introduction of radical innovation can positive moderate the relationship between R&D intensity and underpricing in IPO. This result produces important implication for managers. Only increasing R&D intensity will not bring high market value in an IPO. Except for reducing information asymmetry, managers also have to pay attention to take effort to develop break-

through innovations. This strategy makes it more difficult for investors to underestimate a firm's value when firms' expenditures are high and may translate into an accurate IPO price. However, when investors can evaluate a firm's effort through using clear results like patents, they may take more care to compare companies and then the introduction of radical innovation can't help firms ensure that their IPOs are not underpriced.

Third, this study added "strategic competition" into our model, to test its moderating effect of the relationship between innovation capital and underpricing. The results of the empirical tests supported hypothesis 3-1 and also make the mixed relationship between patent stock and underpricing clear, but did support hypothesis 3-2. It suggests that when firms operate in industries with highly strategic competition, investors in IPO markets evaluate the value of one firm's patents according to other firms' reactions to one firm's patent announcement. Competitors' responses influence the investors' profit expectations of one firm's patents. Consequently, in industries characterized as having highly strategic competition, investors may doubt a firms' future earning potential, causing them to underestimate a firm's value. This result also has important managerial implications. Firm's value of its effort in introducing patents may be affected by its rivals' actions. Having many patents does not ensure a firm's earnings or market price, and the actual value of a firm's innovation that investors receive and recognize is relative to other firms' efforts

in innovation. Therefore, when firms act in the context of highly strategic competition, managers have to keep an eye on competitors' work and reactions to ensure their own firm's value in an IPO. However, whether the effect of strategic reactions can mitigate or worsen the relationship between R&D intensity and underpricing is still mixed. One possible reason for this is that R&D intensity isn't always clear when it comes to innovation activities. Even in the same industry, different firms' R&D investments may support or develop varying projects in different regimes. Even when one firm increases its R&D intensity and competitors follow suit, investors cannot be sure each firm is developing similar skills or products. This makes it difficult for investors to observe how competitive a market is or evaluate whether a potential investment will lose profits to its competitors. The effect of strategic action is obscured and may not have a clear moderating effect on R&D intensity and underpricing.

Our results also extend the information asymmetry theory of underpricing and find limitation of resource-based theory. Prior empirical work has primarily assessed information asymmetry theory by examining uni-dimensional signals of firm quality, such as firm size and whether the CEO is also the founder. Our study extends this theory by showing it has utility in assessing a core value creation activity of the firm, its innovation activity, and also extends this theory by contextualizing it and showing the effect of

the strategic positioning and strategic competition. Besides, our results suggest the limits of information asymmetry theory. When choosing what to invest in and how much, investors are not only influenced by information asymmetry. They also consider a firm's ability and industrial environment. Therefore, when explaining or exploring the relationship between innovation activities and underpricing in IPO market, researchers can also study from a resource-based view or an industrial-organization view.

On the other hand, prior empirical work shows the limitation of resource-based theory. Traditionally, resource-based view theory identifies that a firm has more valuable, inimitable and non-substitutable resources, it may more likely have better performance. However, in the special condition, IPO market, resource endowment cannot ensure that investors will not underprice firms' IPO prices. That is, when a firm has lots of innovation capital, its IPO price may still be underpriced. The results show that resource-based theory cannot fully explain the phenomena in IPO market.

Several limitations of this study are noteworthy, which may shed light on future research. First, while this study controlled several important influences on firms' IPO price (such as firm's size, age, industry, and the timing of IPO, etc.), literature indicates other factors, such as news or announcements of forming strategic alliances, may also influence the IPO performance (e.g. Kelm et al, 1995; Narayanan et. al., 2000). For

example, forming a strategic alliance with a well-known partner may increase the perceived success rate of innovation projects (Danzon et al., 2005). These kinds of news or announcement will affect the expectation of investors toward firms. However, because of the scope and archival data sources of this research, this study did not include the effects of news or announcements. Future research can add other channels to evaluate their effect on IPO prices by doing event studies.

Secondly, this study took notice of the impact of strategic competition, but this study treated all patents are substitutive, competence-destroying innovation. However, some new patents may be complements of previous patents; that is, some new patents, competence-enhancing innovation, may not rob profit of previous patents but support previous patents. Future research can try more fine-grained approach to the measure of strategic competition by classifying competitors' patents or innovations into two types, namely, competence-enhancing innovation and competence-destroying innovation, to examine the effect of strategic competition on the IPO performance of a firm's innovation capital.

Finally, R&D in services has traditionally been neglected in the literature. Possible reasons for this may be due to the assumption that services do not innovate (Howell, 2000; Tether, 2002). Service do innovate in the wider field such as process improvement

(organizational change) and product development (introduction of new services), but much of (even most of) this innovation does not involve in formal R&D process. Thus, data on services are scarce and result to the difficult of making empirical analysis. If the R&D data of services could be reasonably collected and calculated, future study can extend into service industries.



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