MANAGING ENTREPRENEURIAL GROWTH: TIMING THE IPO

Asda Chintakananda

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Approved by:

Advisor: Professor Hugh M. O'Neill

Reader: Professor Rich Bettis

Reader: Professor John D. Kasarda

Reader: Professor Atul Nerkar

Reader: Professor Jeffrey J. Reuer

ABSTRACT

Asda Chintakananda
Managing Entrepreneurial Growth: Timing the IPO
(Under the direction of Dr. Hugh M. O'Neill)

This dissertation examines how young private firms manage their entrepreneurial growth through the timing of their initial public offering (IPO). While previous research on IPOs has predominantly assumed that the process of "going public" should be timed to maximize financial benefits, anecdotal evidence has shown that the timing of IPOs also has competitive implications for firms' strategic growth. Specifically, this study examines whether firms determine the timing of their IPO launch in accordance with what the theory of entrepreneurial action or real options reasoning would suggest, and how strategic considerations such as competition in both the product market and stock market influences such timing decisions.

Integrating the theory of entrepreneurial action and real options reasoning, competing hypothesis are developed in which strategic considerations such as product market and stock market uncertainty will induce firms to either accelerate or defer the timing of their IPO launch depending on the influence of the venture capitalists. The timing of the IPO launch is also influenced by the level of competition in the product and stock market, as well as the irreversibility of the IPO decision.

The analyses showed clear support for the direct relationship between uncertainty and the timing of IPO: when faced with uncertainty in the product market, firms act in accordance with what the theory of entrepreneurial action would suggest, however, when faced with uncertainty in the stock market, firms act in accordance with what the theory of real options reasoning would suggest. Compared with firms with lower levels of involvement from venture capitalists, firms with higher levels of involvement of venture capitalists are likely to have an early IPO timing. The analysis also supported the assumption that the timing of IPO is also influenced by the existence of competition in the product market and stock market.

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TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Figure

CHAPTER 1: INTRODUCTION

1.1 Background

The management of the timing of a young firm's initial public offering (IPO) has important implications for the firm's growth trajectory. Entrepreneurs face critical tradeoffs in their choice of IPO launch timing—to launch an IPO early or to defer it. There are contrasting views about the appropriate timing of an IPO launch. The predominant view is that launching an IPO early on allows firms to achieve competitive advantages through early acquisition of capital and slack resources (Porter, 1980; Strebel, 1983; Kulatilaka and Perotti, 1998). This is corroborated by the theory of entrepreneurial action in which early action under uncertainty brings a high level of entrepreneurial opportunities to a firm (e.g., Hayek, 1937; Schumpeter, 1934). In contrast, according to the theory of real options reasoning, early action under uncertainty entails the risk of misreading the environment, leading to potential erosion of competitive advantage (e.g., Bowman and Hurry, 1993). However, issues regarding how long a firm should defer its IPO, how strategic considerations or market factors influence this decision, and whether firms act in accordance with the theory of entrepreneurial action or real options reasoning when faced with uncertainty in their IPO launch decisions have not been explicitly examined.

The theories and perspectives of entrepreneurial action, real options reasoning, and competitive dynamics may help us understand how and when entrepreneurs choose to launch their IPO. This dissertation analyzes the tensions among the three theories and perspectives

and predicts the relationship between environmental uncertainty, competition, and the timing of IPOs with respect to high growth entrepreneurial firms.

1.2 Motivation for the Study

This dissertation is motivated by several recent IPO events that run contrary to research expectations. Recent anecdotal evidence has shown that some firms launch their IPOs during "cold" markets, not necessarily during "hot" markets as assumed in the finance literature. For example, Google launched its IPO in 2004, when the market was considered cold (with fewer than 200 IPOs in 2004), whereas Yahoo launched its IPO in 1996, when the market was considered hot (with over 600 IPOs in 2006). Other evidence shows that some firms launch their IPOs in the early stages of their life cycles, contradicting the assumptions in the entrepreneurship literature, which suggest IPO launches occur during later stages of the firm life cycle (e.g., Bhide, 2000). For example, Yahoo launched its IPO just two years after it was founded, rather than 5–7 years later, which is the average age of IPO firms. There is also evidence that some firms do not necessarily launch their IPOs during periods of high returns as assumed in the finance literature. For example, when Yahoo launched its IPO, the average first-day stock return for IPO firms was approximately 20%; three years later, it had risen to approximately 75%. This contradicts the notion that firms should launch their IPO during periods of high returns. Although substantial research on IPOs has been conducted in various academic fields, most of the studies use different assumptions, resulting in several gaps in our understanding of why and when firms go public, and how IPO-related conditions can be managed to achieve growth. This dissertation attempts to provide explanations for some of these recent phenomena and to bridge the gaps in our theoretical understanding of the phenomena.

1.2.1 IPO as a Competitive Dynamic in Strategy and Entrepreneurship Research

Although IPOs have strategic significance for entrepreneurial firms, IPOs remain one of the least-studied topics in the field of strategy and entrepreneurship research (Ireland, Reutzel, and Webb, 2005). Studies in strategy and entrepreneurship have tended to view IPOs as a transition stage that brings about financial growth or "cash-out" opportunities for the founding entrepreneur (e.g., Certo, Daily, Cannella and Dalton, 2003; Pollock and Rindova, 2003). As a result, most studies have focused on either the pre-IPO entrepreneurial firm or the post-IPO public corporation, while paying minimal attention to the IPO stage itself. Of the studies that do consider the IPO stage, most adopt a finance perspective and focus predominantly on "hot markets" (e.g., Ritter, 1984; Louhgran and Ritter, 1995), underpricing (e.g., Welch, 1989; Lerner, 1994a; Rajan and Servaes, 1997), or long-term underperformance (e.g., Brav and Gompers, 1997). These researchers assumed that the IPO is simply a natural end-state of ownership control (e.g., Lerner, 1994b) and that IPOs are conducted for purely financial objectives.

However, recent research and anecdotal evidence suggest that the process employed during the IPO stage may have significant implications for the competitive positioning of the firm. When managed properly, IPOs can lure valuable customers, create new market opportunities (e.g., Bancel and Mitoo, 2001), and attract quality labor (e.g., Draho, 2004). These findings suggest that early IPO timing may allow for greater effectiveness of resource acquisition. In contrast, some studies indicate that the process employed during the IPO stage may subject firms to the leakage of confidential information, placing them at a competitive disadvantage (Chemmanur and Fulghieri, 1999; Subrahmanyam and Titman, 1999). Thus, an early IPO timing may be disadvantageous to the IPO firm. Together, these findings suggest

that research in strategy and entrepreneurship has not adequately focused on the IPO stage itself. Consequently, this stage deserves further research from a strategy and entrepreneurship perspective.

1.2.2 Uncertainty and IPO Decisions: Entrepreneurial Action vs. Real Options Reasoning

Uncertainty is an essential element in the field of strategy and entrepreneurship, and it figures prominently in many empirical studies on firm behavior and decision making (e.g., Tan and Litschert, 1994; Zahra, Neubaum and El-Hagrassey, 2002). However, conflicting outcomes have been produced from research on how firms may respond to uncertainty. Research in the field of entrepreneurship, in particular, the theory of entrepreneurial action, suggests that high levels of uncertainty bring about high levels of entrepreneurial opportunities and that firms that take advantage of these opportunities can gain competitive advantage (e.g., Hayek, 1937; Aldrich and Zimmer, 1986). On the contrary, the theory of real options reasoning states that when high uncertainty in the markets exists, some firms may have difficulty predicting outcomes and thus choose not to act or undertake investments (e.g., McDonald and Siegel, 1986; McGrath, 1999). This potential variability in decision behavior—firms that act entrepreneurially and firms that take a wait-and-see attitude—raises the question of what conditions induce small high-growth firms that have not gone public to act in accordance with the theory of entrepreneurial action or the theory of real options reasoning when determining their IPO launch. In addition, in the case of firms backed by venture capital, decisions regarding the timing of the IPO launch are made jointly by the firm owner and the venture capitalists. In such a case, whether joint decision-making results in firms acting in accordance with an entrepreneurial action approach or a real options reasoning approach has not been previously studied.

Beside the two approaches, entrepreneurs' behavior and decision making under uncertainty may also depend on the specific source of uncertainty that they face. There has been much concern that researchers have not adequately captured the multidimensionality of uncertainty (Boyd, Dess, and Rasheed, 1993; Dess and Beard, 1984). For example, Kogut (1991) used only product market demand uncertainty in measuring firms' propensity to acquire joint ventures, whereas Folta and Miller (2002) used only stock index uncertainty to measure this effect. While these measures may be central to the decision-making process, many researchers treat uncertainty as unidimensional and ignore the varying effects that the different sources of uncertainty may have on firm behavior and performance. Research on IPOs has predominantly featured the stock market as the main source of uncertainty (e.g., Pastor and Verosini, 2005), whereas in reality, financial decisions and product-market decisions are not made separately (Povel and Raith, 2004). Therefore, the influence of multidimensional uncertainty sources on the results of decision making, especially for firms that are at their high growth stage and are contemplating an IPO, merits examination.

1.2.3 Timing as a Decision-Making Criterion: Continuous vs. Punctuated

Research in strategy and entrepreneurship has, in general, ignored timing as a decision-making criterion. The research has mainly used firm profitability (e.g., Rumelt, 1974; Bettis, 1981; Wernerfelt and Montgomery, 1988), market share (e.g., Cool and Schendel, 1987), and firm valuation (e.g., Gulati and Higgins, 2003; Nelson, 2003) as dependent variables. While these are essential criteria for managers in pursuing firm growth, the studies make the assumption that decision making is static and does not vary in timing.

Of the studies that include timing as a decision criterion, most take a continuous approach and view actions across time as events that depend on market situations that are not

cyclical or linked to the past events (Mosakowski and Earley, 2000). Studies under this category view time as a scarce resource, and assume that firm actions are mainly biased toward early timing in order to gain "early-mover" advantages such as network effects, technological advantage, higher productivity, and brand recognition (Lieberman and Montgomery, 1988; Bird and West, 1998). Studies from the financial literature also are generally biased toward early IPO timing (e.g., Subrahmanyam and Titman, 1999; Maksimovic and Pichler, 2000; Schultz, 2000). This bias arises from the assumption of early generation or returns of capital: entrepreneurial firms wish to generate needed capital, and firm owners and venture capitalists want to take firms public as soon as possible in order to reap early returns on investments (Freeman, 1999). This assumption has also been the foundation of IPO studies in the field of strategy and entrepreneurship (e.g., Stuart, Hoang, and Hybels, 1999; Shepherd and Zacharakis, 2001). While early timing may have advantages for venture capitalists and owners, the strategic value of deferring an IPO under competitive uncertainty has not been adequately researched. Given the gaps in our knowledge of the timing of IPOs under competitive conditions, the issue of timing as a decision-making criterion deserves further research attention.

However, some studies in strategy and entrepreneurial research have also taken the punctuated equilibrium view, in which firms evolve through long periods of stability, and that strategic moves or large transformations are undertaken when sudden discontinuous shocks occur in the environment (e.g., Romanelli and Tushman, 1986). IPOs can be regarded as a strategic transformation of a firm, but whether firms respond to a punctuated time flow in IPO decisions is unclear. One view holds that firms are likely to respond more to sudden changes or sudden shocks in the environment as they will be able to gain higher long-term

performance; firms that face small changes in the environment will not accumulate incrementally and result in large transformations (Virany, Tushman, and Romanelli, 1992). However, another view holds that sudden changes or sudden shocks in the environment may bring about information and opportunities that are equally available to all firms, rather than asymmetries of information (Hayek, 1937). In such an event, entrepreneurial opportunities or rents available would be driven to zero (Casson, 1982)—which may defeat the purpose of an IPO as a competitive advantage. Given these discrepancies in time flow approaches (continuous vs. punctuated) with respect to the timing of IPOs, the conditions that lead to the consequences deserve further attention.[1]

1.2.4 Real Options in the Field of Strategy and Entrepreneurship

According to Ireland, Webb, and Coombs (2005), entrepreneurship research is a young discipline with correspondingly low levels of paradigm development. They suggest that the appropriate extension of theories from other scholarly disciplines would support the effective growth of entrepreneurship research. Although real options reasoning has not traditionally figured highly in managers' and entrepreneurs' decision-making processes (Kester, 1984; Copeland and Keenan, 1998; Triantis, 2005), there is evidence that managers do value flexibility (Eisenhardt and Brown, 1998) and growth opportunities (Ireland, Hitt, Camp, and Sexton, 2001) when considering major action. However the extent to which young firms use real options reasoning in making decisions under uncertainty has not been examined. By examining the actions of firms with respect to IPO launches, this study

[1] There is also research on firm investment based on the cycles of the industry. This approach provides some variance on the timing of actions, but is also partially predetermined according to the age of the industry and/or firm. This approach will not be studied in this dissertation but will be controlled for in the model.

enhances our understanding of the ways and conditions that entrepreneurial firms may choose to act in accordance with the theory of real options reasoning.

In addition, despite considerable progress in applying real options reasoning to the field of strategy, most of the research has been conceptual work on the behavior of the firm (Bowman and Hurry, 1993; Kulatilaka and Perotti, 1998; McGrath, 1999; Amram and Kulatilaka, 1999; McGrath, Ferrier, and Mendelow, 2004; Kogut and Kulatilaka, 2004; Adner and Levinthal, 2004) rather than empirical research on the implications of the theory for the firm (Miller and Reuer, 1996; McGrath and Nerkar, 2004). Empirical work using real options has focused mostly on investment decisions that are not integrated within a firm's organizational activities, such as market entry (Kogut, 1991; Miller and Folta, 2002; Folta and O'Brien, 2004) and technology adoption (Scarso, 1996).

1.3 Research Questions and Model

The theoretical framework employed in this research is based on the integration of the theory and perspectives of entrepreneurial action, real options reasoning, and the competitive dynamics. Uncertainty in the product and stock markets and how firm-specific factors (i.e., the influence of venture capitalists in decision making) and industry-wide factors (i.e., competition and irreversibility of the IPO decision) influence such decisions are considered. An understanding of the dynamics of these factors is critical to the understanding of firms' decisions regarding the timing of their IPO launch. Thus, this dissertation attempts to shed light on the following research questions:

1. Does uncertainty in the product market and the stock market increase or decrease young firms' likelihood of launching an IPO?
2. Does the level of venture capitalist commitment affect the IPO launch decision?

3. How does competition in the product market, the stock market, and irreversibility in the IPO decision influence firms' likelihood of IPO?
4. When IPO launches are considered as a strategic decision, does the launch reflect a continuous or a punctuated timeframe?

In Figure 1 I offer an overview of the general research model that will be used to explore these research questions. Although the financial aspects of going public have significant importance in firms' IPO decisions, this research will forgo a detailed examination of the financial arguments in order to focus on IPOs as a strategic consideration. There are several financial factors that influence entrepreneurs' IPO timing decisions that can be incorporated into any research model (e.g., age of firm, age of venture capitalists, industry market-to-book-ratio, and level of borrowing); some of these financial factors were controlled for in the model.

To address the four research questions, I used a hazard model. I analyzed the relationship between firm-specific factors (e.g., the involvement of the venture capitalist in decision making), strategic considerations (e.g., uncertainty and competition in the product and stock markets), irreversibility in the IPO decision, market shocks, and likelihood of IPO (or time-to-IPO). I measured the dependent variable in terms of the likelihood of the IPO taking place at any given point of time rather than the actual length of time between the founding of the firm and the IPO launch because of the inclusion of firms in the data set that had not launched an IPO by the end of the observation period. The analysis was conducted on a sample of over 2,600 private firms in the manufacturing industry that were founded during 1980–1996. Firms that eventually went public (829 firms) and firms that remained private at the end of the study timeframe were included in the analysis.

1.4 The Importance of the Study

This dissertation makes several contributions to the field of strategy, entrepreneurship, and IPO research. First, it enhances our understanding of the strategic considerations in IPO timing decisions, including the flexibility that comes with a later IPO launch timing and the competitive advantages arising from an early launch. Second, this research also provides insights into the decision-making mechanisms of high growth entrepreneurial firms with respect to the product market and stock market, and how these decisions are affected when made jointly with venture capitalists. Third, this study highlights the roles of competition for resources and market competition in the decision to launch an IPO. These factors have not been addressed in previous studies on IPOs. Fourth, this dissertation extends previous theoretical and conceptual work on firms' use of option reasoning into an empirical examination of the implications of options decisions within an organization. Finally, this work provides valuable insights into the genesis and behavior of high-growth firms and the early stages of their organizational development.

1.5 Overview of the Dissertation

This introductory chapter provides a brief overview of the motivation for the study, the research questions and model, and the contribution of the study to the fields of strategy and entrepreneurship. Chapter 2 briefly reviews the literature on IPOs from the field of entrepreneurship, strategy, and finance. It then reviews the literature on entrepreneurial actions, real options reasoning, and competitive strategy. In chapter 3, I draw on the review in chapter 2 to provide a critique of the literature and propose theories that may address the gaps and contradictions in the literature that explain how and when entrepreneurs choose to launch their IPO. In chapter 4, I develop testable hypotheses that explain firms' likelihood of

launching an IPO. In chapter 5, I provide the details of the research methodology used to test the hypotheses, and in chapter 6, I provide the results of the testing. Lastly, in chapter 7, I discuss the implications and limitations of this study, and propose directions for future research.

CHAPTER 2: REVIEW OF RELEVANT LITERATURE

Research on firm's decisions has been conducted at many stages of a firm's development, from small start-up firms that are fully private to large firms with shares owned by the public. As this dissertation focuses on decisions of firms that have passed their start-up phase and are approaching the possibility of an IPO, the literature review in this chapter mainly focuses on the external causes of firms' entrepreneurial behavior rather than on biases and heuristics at the individual level.

As IPOs have been researched in the field of entrepreneurship, strategy, and finance, this chapter briefly reviews the literature from all three fields. The chapter starts with a review of the theory and findings underlying firms' IPO decisions in the entrepreneurship, strategy, and finance literature. Next, the literature relevant to IPO decision timing in each field is reviewed. Lastly, theories relevant to entrepreneurial growth through an IPO in a strategic context and its timing are reviewed. The discussion in this chapter sets the basis for the next chapter, which is a critical review of the gaps and contradictions in the theories relevant to IPO decisions and timing.

2.1 IPOs in Entrepreneurship Literature

Research on IPOs in the entrepreneurship field has mainly focused on the harvesting of investments and the retention of ownership and control of the firm (see Table 1 for a summary).

2.1.1 Lifecycle

In the entrepreneurship literature, IPOs are viewed like "harvesting crops" of a business investment in order "to collect terminal after-tax cash flows on the investment that was initially 'planted'" (Prasad, Vozikis, Bruton, and Merikas, 1996). The process is viewed as part of the organizational life cycle that typically occurs during the final stage of the entrepreneurial development (Smith and Smith, 2000:566). The organizational life cycle is based on the assumption that there are five common stages in a firm's development: birth, growth, maturity, revival, and decline (Churchill and Lewis, 1983; Miller and Friesen, 1984; Lester, Parnell, and Carraher, 2003). Research in this area is concerned with understanding the characteristics of firm behavior under each predetermined growth stage. Therefore, the progression and duration between each stage is assumed to be predetermined. The organizational life cycle theory has been used in various fields to understand the process and planning of firms (e.g., Smith, Mitchell, and Summer, 1986; Hanks 1990, Birley and Westhead, 1990; Hanks, Watson, Jansen, and Chandler, 1993). Research on IPOs using the lifecycle theory mostly focuses on the alternatives for fund raising during the firm's high growth stage (e.g., Prasad, Vozikis, Bruton, and Merikas, 1996) or how the firm's geographic location can accelerate the time to harvest an IPO within the high growth phase (Shepherd and Zacharakis, 2001).

2.1.2 Separation of Ownership and Control

In contrast with viewing IPOs as an opportunity to harvest, some entrepreneurs may view their firm as a life-time commitment and prefer to seek alternative investments—the loss of ownership and control of their firm signaled by an IPO would be a last resort. Research in this field describes the difficulties entrepreneurs have in relinquishing control

and the alternative ways of financing the firms. According to Bhide (2000), entrepreneurs must be highly ambitious to start a firm, and such strong ambitions are typically followed by unwillingness to relinquish control regardless of their ability to support firm growth. This unwillingness is also driven by entrepreneurs' efforts to ensure that the growth and development of the firm conforms to their own vision rather than according to other views or trends into the future. In addition, ownership cannot be easily transferred as the value of firm is tied to the identity of the entrepreneur who built it. The identity tied to the firm may include the entrepreneurs' personal knowledge and skills, reputation, and legitimacy. These are regarded as critical resources of the firm that cannot be transferred to other individuals, and thus firms are likely to launch an IPO only when necessary.

2.2 IPOs in the Strategy Literature

This section reviews IPO studies in the strategy literature. I will review the IPO literature in this field starting from the timing of the IPO, and the valuation and pricing of the IPO to the post-IPO consequences such as the survival, corporate development, and new venture founding of the IPO firm (see Table 2 for a summary).

2.2.1 Timing

The first major decision for a firm planning to launch an IPO is when to do so. To date, only two empirical studies have been carried out on the timing of IPOs in the field of strategy (Stuart et al., 1999; Shepherd and Zacharakis, 2001). Stuart et al. (1999) used a social network perspective to examine how firms use the prominence of their strategic alliance partners to speed the timing of their IPO. They found that investors look to the prominence of the firms' partners as a signal about the quality of the firm—firms with prominent partners can launch their IPOs earlier than those without. Shepherd and Zacharakis (2001) examined

firms' IPO timing and found that it is also influenced by the firms' type of industry and geography location. Their results show that firms in the West and Midwest were typically launched IPOs earlier than others, and the speed of IPO launch varied by industry.

2.2.2 Pricing

The next major decision in the IPO process for a young entrepreneurial firm is how to maximize the proceeds and benefits from an IPO. Valuation and under-pricing of the IPO is the most empirically researched area in the field of strategy. This is not surprising as the valuation and under-pricing of the firm during the IPO process is directly related to the firm's wealth creation. The valuation of a firm's stock at the time of the IPO is measured as the difference between the firm's market valuation and its book value. High market valuation in comparison with the book value brings about greater financial resources that may be used either to support the firms' financial activities or as a financial reward for the owners and venture capitalists. Underpricing is the difference between the price at which the firm initially sold its stock during the first day of the IPO and the actual trading price of the firm's stock at the closing of the first day of the IPO; the greater the difference, the higher the level of underpricing. The level of underpricing is important to the IPO process because high levels of underpricing makes the firms/entrepreneurs "leave money on the table," forgoing money that might have been retained.

Research in strategy has predominantly used signaling theory combined with the chief executive officer (CEO) founder status and the composition of the top management team (Andrews and Welbourne, 2000; Cyr, Johnson, and Welbourne, 2000; Certo, Daily, and Dalton, 2001; Filatotchev and Bishop, 2002; Nelson, 2003; Cohen and Dean, 2005) or the signaling theory combined with the social networks of the firm (Cyr, Johnson, and

Welbourne, 2000; Certo, 2003; Gulati and Higgins, 2003; Pollock and Rindova, 2003) as the determinants of firm performance and the underpricing at IPO. However, a review of the literature reveals little consistency on the effects of firm signaling and underpricing (e.g., Daily, Certo, Dalton, and Roengpitya, 2003).

The CEO founder status influences both the firm valuation and underpricing during the IPO. Certo, Cohen, Daily, and Dalton (2001) found that having a founder CEO during the IPO may require underpricing because investors have uncertainty in the founder CEO's ability to make an effective transition to a professional style of management. However, the degree of underpricing is lower when there is a high proportion of inside directors, as inside directors are likely provide better support in terms of firm-specific knowledge. While Certo et al. (2001) focused on the effects of CEO founder status on wealth retention, Nelson (2003) focused on the effects of the presence of the CEO founder during the IPO on wealth creation. Nelson (2003) found that having a CEO founder during the IPO may instill confidence in investors as founders are more likely to exercise strong strategic leadership in firm governance post-IPO than are nonfounders. In addition to the status of the CEO founder, the announcement of the CEO's remuneration can also play an important role in signaling the value of the firm to investors. Certo, Daily, Cannella, and Dalton (2003) found that announcing the CEO's compensation package during the IPO process lead to higher valuations of the firm.

Beside the CEO founding status, the composition of the top management team and the board of directors influences the valuation and underpricing of IPO firms. Cohen and Dean (2005) and Lester, Certo, Dalton, Dalton, and Cannella (2006) followed the approach by Certo et al. (2001) and Nelson (2003) and examined the role of the top management team

in signaling the quality of the firm to potential investors. They found that legitimacy of the top management team, as measured by experience, age, affiliation with nonprofits, and education, is negatively related to IPO underpricing. The board composition can also signal the firm's quality to investors (Filatochev and Bishop, 2000; Certo, Daily, and Dalton, 2001). Filatotchev and Bishop (2002) found that executives' ownership of shares provided investors with signals of quality. Diversity of the board provided investors with signals that the board members have experience, connections, and the incentives to take an active role in the decision-making process that leads to less underpricing. Similarly, Certo, Daily, and Dalton (2001) found that the size and reputation of the board can provide signals regarding the quality of the firm to investors, leading to lower underpricing.

Firms can also use strategic alliances as signals of their quality, to influence the valuation and underpricing of the firm. This was evident in the findings of Stuart et al. (1999) that the prominence of firms' strategic alliance partners increased the valuation of the IPO. Gulati and Higgins (2003) extended the findings of Stuart et al. (1999) by examining the effects of the different types of alliance partners on firm valuation. They found that ties to venture capitalists are beneficial to higher firm valuations during cold markets, and ties to prominent investment banks are beneficial to higher firm valuations during hot markets. This is because venture capitalists are likely to be overly optimistic about the upside of firms launching an IPO when the market is favorable. A social structural perspective has also been used to examine underpricing. Pollock and Rindova (2003) found that the amount of information in the media influenced lower levels of underpricing and higher stock turnover on the first day trading, both at a diminishing rate.

2.2.3 Firm Survival

How the IPO process affects the survival of the firm post-IPO is important to a firm's long-term strategy. According to Jain and Kini (2000) and Fischer and Pollock (2004), the survival rate of IPO firms after the first five years post-IPO is about 70–75%. This can be attributed to the large transformation in the firm's organizational structure and culture, business boundaries, activity systems, and competitive positioning (Aldrich and Ruef, 2006; Fischer and Pollock, 2004; Draho, 2004). Despite such importance, to date, only three studies in the field of strategy and entrepreneurship have focused on how the IPO process employed may impact firms' survival (Welbourne and Andrews, 1996; Andrews and Welbourne, 2000; Fisher and Pollock, 2004).

Welbourne and Andrews (1996) examined firms' human resource strategy during the IPO process and found that firms that place more value on their employees and have organization-based compensation programs during the IPO period may have a lower Tobin's q during the short term, but are more likely to survive in the long term. They followed up their study by examining the choice of such tradeoff and found that CEOs with finance training will identify with the investment community and perform well at IPO, but will have lower levels of human resource values needed for the long-term survival (Andrews and Welbourne, 2000). Fischer and Pollock (2004) found that the presence of the CEO founder, the concentration of stock ownership in the CEO's or venture capitalists' hands, and key interorganizational networks can protect the firm during the IPO process and enhance the firm's ability to survive.

2.2.4 New Venture Founding

To date, only one study has addressed how firms that have gone public can support an increase in new venture foundings (Stuart and Sorenson, 2003). Stuart and Sorenson (2003) examined biotechnology firms and found that IPOs increased the creation of new ventures due to two effects: enhanced legitimacy and financial resources. First, firms have established relationships with various parties such as potential customers, strategic partners, and venture investors, and going through an IPO demonstrates the firm's ability to withstand uncertainty and the entrepreneurs' ability to lead the organization. Second, IPOs enable high-level employees to sell their equity holdings and to exploit their expertise and contacts necessary to mobilize financial resources and human resources to create new firms. In addition, there are spill-over effects as going public influences the aspirations of other entrepreneurs by signaling the availability of resources for a particular type of company (Ritter, 1984).

2.3 IPO in the Finance Literature

This section reviews IPOs in the finance literature. Because the finance aspect of IPOs has been extensively researched and is well documented, it would be impossible to review it all. Thus, I develop a broad picture of the major research based on three types of benefits of an IPO launch to a firm: (1) financial benefits, (2) managerial benefits, and (3) competitive benefits. (See tables 3–5 for a summary).

2.3.1 Financial Benefits

Firms may launch an IPO based on financial needs such as overcoming financial constraints (Myers and Majluf, 1984; Black and Gilson, 1998), reducing financial costs (e.g., Amihud and Mendleson, 1988; Chemmanur and Fulghieri, 1999), or obtaining cash-out opportunities (e.g., Pagano, Panetta, and Zingales; 1998; Loughran, Ritter, and Rydqvist,

1994). Financial constraints may occur if an entrepreneur has private information that is not recognized by financers. In this situation, funding from external sources becomes constrained, and if available, comes only at higher costs (Myers and Majluf, 1984). In addition to information asymmetries, Black and Gilson (1998) documented that banks' conservative approach in lending to entrepreneurial firms does not reward entrepreneurial behavior, but punishes failure. Such a lending approach constrains the growth potential of entrepreneurial firms. These two constraints are likely to increase as firms enter into their high growth phases. Thus, by launching an IPO, firms gain to the ability to mitigate the constraints and raise capital directly.

Going public also helps firms reduce overall financing costs through increased bargaining power. By launching an IPO, firms gain fully diversified shareholders, which provide firms with greater bargaining power to lower their costs of financing (Rajan, 1992; Chemmanur and Fulghieri, 1999). Amihud and Mendleson (1988) view the IPO as a liquidity enhancing project in which increased liquidity allows firms to effectively reduce their cost of capital. This was supported by Booth and Chua (1996), who found that public firms with improved liquidity tended to have lower required rates of return. There are many possible explanations for this reduced rate of borrowing for public firms. Diamond (1991) stated that entrepreneurs first obtain financing from banks, which entails high costs in monitoring the firm, thus increasing the borrowing rate banks impose. However, after a certain stage, firms can free ride on the monitoring provided by the banks and raise capital through other means at lower rates. This finding was supported by Pagano and Röell (1998), who found that if the amount of funding required is very large, the cost of monitoring will reach a point when new public financing will become cheaper. Rajan (1992) found that by having a balance between

financing from banks and the capital market, firms can reduce the bargaining power of banks and gain an overall lower financing costing.

Firms can also use an IPO launch as a cash-out opportunity. This notion was evident in research that found that for some firms, investments may actually decline after an IPO launch despite better financing conditions (e.g., Pagano, Panetta, and Zingales; 1998; Loughran, Ritter, and Rydqvist, 1994). Zingales (1995) documented this phenomenon and stated that entrepreneurs decide to launch an IPO in order to maximize their gain from selling their firm through a change in the proportion of cash flow rights and control rights. Beside entrepreneurs, venture capitalists and the venture capital providers also benefit from cashing out through IPOs. Black and Gilson (1998) state that as the firm progresses, the services that venture capitalists provide to the entrepreneur lose efficiency, thus an IPO allows venture capitalists to exit and reinvest the capital obtained.

2.3.2 Managerial Benefits

While the majority of the finance literature on IPO decisions has focused on the financial benefits of IPOs, recent finance studies have begun to explore the managerial benefits. IPOs can be used by entrepreneurial firms to align managerial incentives (e.g., Burkart, Gromb, and Panunzi, 1997; Pagano and Röell, 1998), enhance investment efficiency (Dow and Gorton, 1997; Ang, Cole, and Lin, 2000), increase publicity (Ravasi and Marchisio, 2003; Rydqvist and Hogholm, 1995) and legitimacy (e.g., Ritter and Welch, 2002), as well as prepare for potential mergers (e.g., Rock, 1994).

Going public provides firms with better managerial incentives by eliminating excessive monitoring by lenders, which may reduce efficiency in daily decision making (Holdstrom and Tirole, 1993; Burkart, Gromb, and Panunzi, 1997; Pagano and Röell, 1998;

Bolton and Von Thadden, 1998). Holmstrom and Tirole (1993) explored the value of the stock market as a managerial performance monitoring tool and concluded that high liquidity and less concentrated ownership is associated with greater managerial incentives and market monitoring. Burkart, Gromb, and Panunzi (1997) and Pagano and Röell (1998) state that the elimination of excessive monitoring through public status can enhance managerial efficiency. Firms that receive private funding from large external shareholders may be subject to excessive monitoring which may actually reduce managerial efficiency. This view is supported by Bolton and Von Thadden (1998) who stated that higher liquidity demands by multiple investors will lower firms' cost of management and raise potential benefits from correcting managerial failures. In addition, managers can make better decisions when they rely on stock prices. This is because, according to Dow and Gorton (1997) and Ang, Cole, and Lin (2000), information on stock prices will guide managers to value maximization by providing information on investment opportunities and information about their past decisions.

IPO launches also provide firms with increased awareness among consumers (Ravasi and Marchisio, 2003; Rydqvist and Hogholm, 1995). Ravasi and Marchisio (2003) surveyed CEOs of Italian firms and found that higher visibility played an important role in entrepreneurs' decision to become public. Similar results were also found by Rydqvist and Hogholm (1995) who found that firms listed reputation factors in their prospectuses as major reasons for going public. These results were supported by the study of Demers and Lewellen (2003) on the relationship between launching IPOs and the increase in firms' website traffic. Demers and Lewellen (2003) found that firms' website traffic, an indicator of product market performance for internet firms and of publicity effects, increased during the IPO period.

Besides enhancing awareness, launching an IPO can provide signals to consumers about firms' product quality. Maksimovic and Titman (1991) found that all equity firms have incentives to produce products of higher quality that may reduce short-term profits but will develop consumers' perception of consistent high quality over time. This view was supported by Stoughton, Wong, and Zechner (2001), who stated that consumers discern product quality from firms' stock price. Similarly, Pagano, Röell, and Zechner (2002) examined European firms that cross-listed on stock exchanges in the United States and found that firms that cross-listed pursued a strategy of rapid expansion and relied heavily on exporting. This supports the notion that IPOs provide publicity and enhanced awareness of the firm.

Beside product awareness among consumers, public firm status also increases firms' legitimacy among customers, suppliers, and resource holders (Ritter and Welch, 2002; Shane and Cable, 2002; Stuart and Sorenson, 2003). This is because proven records of firm success through different stages reduce the uncertainty associated with the firm and demonstrate a track record that inspires more confidence and loyalty among affiliates (Aldrich and Fiol, 1994). Such legitimacy also allows management to attract the resources required for further corporate development (Stuart and Sorenson, 2003). Increase in awareness and legitimacy is not limited to stakeholders and consumers, but is also available to potential buyers of the firm (Zingales, 1995). This is because an IPO launch provides management with the ability to negotiate future acquisitions, as stock and cash can be included in any deals (Rock, 1994). Also, by selling stocks to dispersed shareholders in the first stage, and selling the control rights directly through bargaining with a potential buyer in the second stage, the entrepreneur can minimize haggling during the merger and acquisition negotiations.

2.3.3 Competitive Benefits

In addition to financial and managerial benefits, finance literature and anecdotal evidence suggest that IPO launches have implications for a firms' competitive strategy. By launching an IPO, firms gain critical resources such as capital, human resources, and knowledge, as well as the legitimacy needed to support valuable growth opportunities. Myers (1977) notes that firms have discretion over future investments such as investments in research and advertising, which enhances growth opportunities. If so, an IPO can help firms manage their latent growth opportunities by providing the resources necessary to fund the growth opportunities. Fischer (2000) examined German firms that went public and found that growth opportunities based on capital expenditures, sales growth, intangible assets, and research and development intensity are important to the determinants of firms launching an IPO. This suggests that IPOs can be a vehicle to acquire resources to manage latent growth opportunities within the firm. Early acquisition of such resources and rapid growth can support firms in their preemption of resources and market opportunities from rivals. However, there have been few empirical studies on IPOs as a preemptive move in the product market.

The required disclosure of information after an IPO launch may also benefit a firm's competitive standing. Literature in finance has predominantly focused on the trade-offs between gaining cheaper funding and having to disclose proprietary information to competitors (Bhattacharya and Ritter, 1983; Gertner, Gibbons, and Scharfstein, 1988; Bhattacharya and Chisea, 1995; Yosha, 1995). However, recent literature has shown that disclosure of information may benefit certain firms by inducing less aggressive tactics from rivals. Draho (2004) argued that rivals could choose to respond more aggressively against

firms that have been disclosed to be of low quality in order to drive them out of the market. Perotti and Von Thadden (2003) argued that firms of high quality will be faced with high expectations and less aggressive tactics from competition, thus benefiting from increased disclosure as the public information will deter competition from aggressive behavior. Neither has empirically tested these arguments. Therefore, the issue of the relationships before IPOs and the competitive positioning deserves to be tested.

Beside disclosure of information, high leverage may also induce predatory behavior from rivals. Firms that have high leverage are more likely to behave cautiously and be less aggressive in the product market (Brander and Lewis, 1986; Bolton and Scharfstein, 1990). This is because highly leveraged firms may lower their physical capital investments in order to minimize the assets that would be lost to debt holders in case of bankruptcy (Brander and Lewis, 1986; Bolton and Scharfstein, 1990). Such behavior reduces firms' ability to compete (Kovenock and Phillips, 1997) and can encourage more aggressive behavior from rivals (Teslar, 1996; Kanatas and Qi, 2001; Khanna and Tice, 2000; Fudenberg and Tirole, 1986; Bolton and Scharfstein, 1990). Rival firms can also take advantage of the leveraged firms' need for refinancing by signaling that a firm will be unprofitable and motivating investors to deny the firm financing (Fudenberg and Tirole, 1986; Bolton and Scharfstein, 1990). Rival firms can also directly pursue aggressive expansion and price reduction tactics against leveraged firms (Chevalier, 1995a and 1995b). Therefore an IPO launch could reduce rivals' predatory tactics by reducing leverage.

2.4 The IPO Timing

This section reviews how the timing of IPOs has been studied in the entrepreneurship, strategy, and finance literature. In reviewing the literature on IPO timings, I use the

framework by Mosakowski and Earley (2000) in which time flow can be categorized into three assumptions: cyclical/lifecycle, continuous/novel, or punctuated time flows.[2] The cyclical time flow (or lifecycle time flow), which has been used in traditional strategic management research, is a cycle in which patterns of events may repeat across firms at certain stages of the firm or of the industry (Miller and Friesen, 1984). In contrary to the cyclical time flow, the continuous time flow (or novel time flow) assumes that patterns of events across firms or within industries do not exist; future events or occurrences that a firm may face are not linked to the firm's past. The assumption that distinguishes the potential future events from past events has been the basis for research on the real options theory (Mosakowski and Earley, 2000). Lastly, the punctuated time flow assumes that sudden changes may create discontinuous shocks that could lead to differences in firms' decisions and outcomes. The assumption of discontinuous shocks has been the basis for research on technological change and entrepreneurial search (Mosakowski and Earley, 2000).

2.4.1 Life Cycle / Industry Cycle

Literature on lifecycles in the field of entrepreneurship and finance has assumed that an IPO occurs during or immediately after a firm's rapid growth stage, when the entrepreneur will either harvest previous investments or continue to seek investments to support the firm's growth. At this stage, firms will experience changes in information available to outsiders and in levels of cash flow. For example, Maug (2001) suggested that firms go public during the period in the firm's lifecycle when outsiders have better information to evaluate the firm's growth prospects than insiders. Schultz (2000) and Beninga, Helmantel, and Sarig (2005) stated that the timing of an IPO occurs when the firm's cash flow level rises to the point that

[2] The rationale for using time flow in understanding IPO timing is described in section 1.2.3.

the firm's value as a privately held equity is equal to the value of the firm as a publicly traded company. At this point, firms will launch an IPO because their value from better diversification of risk will begin to exceed the private benefits of control. Similarly, Boehmer and Ljungqvist (2004) found that announcements of improvements in firms' sales, earnings growth, and profit margins enhance favorable returns in the stock market, which in turn increase the likelihood that a firm will go public.

The timing of IPOs can depend on the level of information about the value of the firm that is available in the market (e.g., Myers and Majluf, 1984; Benveniste, Busaba, and Wilhelm, 2002; Chemmanur and Fulghieri, 1999; Maksimovic and Pichler, 2000). Myers and Majluf (1984) and Bayless and Chaplinsky (1996) stated that firms will launch their IPO when information asymmetries about the value of the firm between the firm and the investors are low. Although a firm may want to capitalize on the information asymmetries between the firm and investors and launch the IPOs during high asymmetries in order to gain large amounts of capital, investors may be aware of the firms' incentives. With investors' awareness that firms will have an incentive to go public when information asymmetries exist in order to gain large amounts of capital, firms will be forced to launch their IPO during low levels of information asymmetry. Alti (2005) stated that high price realizations for firms that go public early may be due to better reflection of investors' private information, which triggers a larger number of subsequent IPOs than when low offer price realizations occur.

Beside focusing on the internal aspects of IPO timing using the lifecycle approach, research in finance has also emphasized industry cycles or external cyclicality aspects in IPO timing. These timing decisions can be categorized as "windows of opportunity" or availability of market information. Research on windows of opportunity suggests that the

timing of IPOs can be subject to cyclicality in the industry, and that IPOs are timed to exploit these peaks in order to gain favorable financing terms (Shiller, 1990; Rittter, 1991; Loughran, Ritter, and Rydqvist, 1994; Loughran and Ritter, 1995). Thus, when the stock market enters a cycle of overall high valuations, firms will be willing to launch their IPO in order to reap the benefits quickly (Pagano, Panetta, and Zingales, 1998).

2.4.2 Continuous Time Flow

Literature on IPOs as a continuous time flow assumes that launching IPOs early allows firms to generate the capital needed to support growth sooner and allows venture capitalists to obtain their returns on investments earlier (Freeman, 1999). This is because early IPO launches provide firms with resources for early growth and provide investors and owners with higher real returns on investments. This has been the basis for the only two empirical studies on the timing of IPOs in the field of entrepreneurship and strategy (Stuart et al., 1999; Shepherd and Zacharakis, 2001), which were reviewed in the previous section.

2.4.3 Punctuated Time Flow

Researchers in the field of entrepreneurship have also viewed firm transformations with a punctuated view of time flow. This view depicts firms as evolving through long periods of stability, with sudden discontinuous shocks that provide incentives to transform (Romanelli and Tushman, 1994). Although firms can undergo transformation during any period as a result of changes in external conditions, Romanelli and Tushman (1994) argue that small changes that a firm faces will not accumulate incrementally as large transformations. In addition, Virany, Tushman, and Romanelli (1992) assert that firms that make sudden changes in response to sudden shocks in the environment obtain higher long-term performance than firms that did not transform, or were transformed during the period

without any sudden shocks in the environment. However, most of the research in this area has focused on technology change and its impact on firm transformation (Tushman and Anderson, 1986; Romanelli and Tushman, 1994). In the context of product markets, according to Kogut (1991), sudden changes in market demand can induce firms to take advantage of the opportunities. However, whether sudden changes in the market support firms' needs for an IPO has not been studied.

2.5 Uncertainty

While research on IPOs under a competitive strategy perspective has been based on the objective state of the external environment, how uncertain conditions of the environment affect the timing of the IPO has been ignored. A review of uncertainty is important because decision making under uncertain conditions is essential to competitive strategy. In this section, I summarize the literature on uncertainty that will form the basis for the theoretical development on IPO timings in the subsequent chapters.

Many definitions of uncertainty have been used in the strategy literature. In general, uncertainty occurs when "the probabilities of alternative outcomes cannot be determined by a priori reasoning or statistical inference" (Casson, 1982:371). This definition aligns with that of other researchers who define uncertainty as the inability to predict the likelihood of future events or outcomes (e.g., Lawrence and Lorsch, 1967; Duncan, 1972). It is important to distinguish the definition of uncertainty from the definition of risk or volatility: if events or outcomes change in predictable ways, substantial risk or volatility may exist, but there may be little uncertainty (Miles and Snow, 1978). The distinction is important because it is the presence of uncertainty, not risk, that provides entrepreneurial opportunities (Jones and Butler, 1992). This follows financial logic that the reward for risk is predetermined according

to the degree of risk that an individual or firm undertakes, whereas entrepreneurial profits are "the above normal returns upon acting upon unique uncertainties or opportunities for which objective probabilities cannot be calculated" (Jones and Butler, 1992).

Uncertainty in decision making is induced when managers do not understand how the components of the environment may be changing (Milliken, 1987). Under uncertainty, the environment is the source of information, which is filtered by managerial perceptions (Lawrence and Lorsch, 1967; Galbraith, 1973). Information in the market that may affect IPO timing includes the product market and the stock market. Although no research explicitly links the product market with the stock market in the IPO decision, some research does suggest that the linkage may exist. According to the entrepreneurship literature, when product market demands increase, entrepreneurs will respond by increasing their firm capacity (Bergh, 1998). Similarly, when the trends in the financial markets are favorable, entrepreneurs will respond by taking advantage of the favorable conditions in order to acquire higher levels of slack resources. As IPOs support capacity increase as well as resource acquisition, entrepreneurial firms are likely to incorporate the conditions in the product market into their IPO decisions. However, the linkage has not been tested directly.

2.5.1 Product Demand Uncertainty

Product demand uncertainty is generated by rapid shifts in consumer preferences and needs resulting in an inability to predict or gauge future demand for products (Jones, Hesterly, and Burgatti, 1997). The level of product demand provides information on the potential sales and profit available to a firm; thus it provides a direct indication of the degree to which a firm may need to prepare its resources and production capacity to meet the anticipated demand or to gain the potential share. Beside a shift in consumer preferences and

needs, product demand uncertainty is also generated by rapid changes in knowledge and technology, which may result in a change in the life cycle of the product, requiring changes in resources, production capability, and product process (Garud and Kumaraswamy, 1993). Product demand uncertainty has been used as a source of uncertainty in various strategy literature. For example, Balakrishnan and Wernerfelt (1986) found that product demand uncertainty makes vertical integration risky owing to potential obsolescence. Mariotti and Cainarca (1986) found that under conditions of product demand uncertainty, firms disaggregate into autonomous units and outsource in order to develop their ability to respond to a wide range of contingencies. In the context of IPOs, firms base their resource requirement and production expansion needs on the level of product demands (Bergh, 1998). As discussed in the previous sections, product decisions and financial decisions are not made separately (Povel and Raith, 2004), and IPOs support firms' expansion needs and growth. Under this assumption, the level of uncertainty in product market demands is likely to influence the timing of IPOs. However, the linkage between product demand uncertainty and IPO decision has not been empirically tested.

2.5.2 Stock Return Uncertainty

Stock return uncertainty is generated by rapid shifts in the value of firms' stocks. The value of a firm's stock is the sum of the discounted value of future cash flows expected to be generated from assets in place and the net present value of expected cash flows from investment opportunities that are expected to be generated by the firm in the future (Brealey and Myers, 1988). The value of the firm changes as its performance changes and as investors' expectations about the cash returns from the firm's current and future assets change. Information that may influence firms' assets include country-level information (e.g.,

political factors), industry-level information (e.g., market entry opportunities, licensing opportunities, and changes in resources and technology), and firm-specific information (e.g., firm resources and capabilities). Thus the overall value of the stock returns within the same industry provides a general indication of the degree investors may be willing to provide financial resources to firms—an important indicator to private firms in which their firm value may not be inferred from their stock prices. Such supply of financial resources will allow firms to prepare their resources and production capability to manage their latent growth potential. Stock return uncertainty has been used as a source of uncertainty in various strategy literature. For example, Gulati and Higgins (2003) and Stuart et al. (1999) used stock market indexes and returns as a measure of industry uncertainty for biotechnology firms.

2.6 Capital Funding

Firms that have high growth aspirations require funding to support their development prior to an IPO. The following sections will briefly describe the types of funding most common to pre-IPO firms.

2.6.1 Venture Capital

The most common source of funding among high growth firms is through venture capital, which is involved in close to half of all IPOs in the United States (Jain and Kini, 2000). Venture capitalists not only provide necessary funding to firms, but also provide firms with business advisory support. Venture capitalists support entrepreneurs in their IPO launches by providing access to large amounts of capital at reduced costs (MacMillan, Kulow, and Khoylian, 1989; Sahlman, 1990). Venture capitalists are also able to guide entrepreneurs, who often have limited knowledge and managerial skills in a particular industry, by leveraging their knowledge gained in their support of other firms in their

portfolio (e.g., Tyebjee and Bruno, 1984; Rock, 1987; Timmons, 1994; Jain and Kini, 2000). Such support helps entrepreneurial firms create value by coordinating when firms should launch their IPO (Schultz, 2000). The level of support from the venture capitalists also varies according to the degree of involvement, which ranges from limited involvement to direct involvement, sometimes including voting rights on key decisions (MacMillan et al., 1989; Zider, 1998).

Despite the support that venture capitalists provide to entrepreneurial firms, empirical results on the performance of venture capital-backed firms as a result of association with venture capitalists has been varied. One group found that the presence of venture capitalists had a significant effect on the performance of firms during the IPO launch and performance after it; another group found no significant effects during the launch or after.

Megginson and Weiss (1991) and Barry, Muscarella, Peavy, and Vetsuypens (1990) found that venture capital firms' certification role mitigates information asymmetries and brings about lower levels of underpricing during the IPO launch. In addition, venture capitalists' active involvement that influences the actions of managers on strategic resource decisions also brings about higher long-run post-IPO performance (Brav and Gompers, 1997) and higher survival rates (Jain and Kini, 2000). Other researchers found no effects from the presence of venture capitalists, and explained this with several theories. Amit, Glosten, and Muller (1990) suggested their lack of results may be because strong entrepreneurial firms may be able to launch an IPO without venture capitalists' support; thus venture capitalists only attract weaker firms that are forced to sell their equity interests. Admati and Pfleiderer (1994) suggested that internal agency issues may mitigate any long-term post IPO benefits that the firm could receive. This is because as venture capitalists become part of the firm,

they may perpetuate an over-investment problem and use other people's money to invest in value destroying projects.

As the potential role and influence of venture capitalists on venture capital-backed firms' behavior and resulting performance is still unclear, this issue deserves further attention.

2.6.2 Other Capital Sources

Two other sources of funding are mezzanine financing and issuance of preference shares. Mezzanine financing is typically used when firms have reached their bank borrowing limits, but still want large sums of capital without having to issue equity. Unlike venture capitalists, investors who provide mezzanine financing do not provide business advice or require firms to provide them with voting rights. Other sources of funding include issuance of preference shares. Preference shares provide investors with a fixed rate of dividends, but no voting rights.

2.7 Summary

In this chapter I reviewed the literature relevant to IPO decisions and timing in all three fields—entrepreneurship, strategy, and finance. In the next chapter I address the gaps and provide a critical review of the literature.

CHAPTER 3: CRITICAL REVIEW

This chapter provides a critical review of the literature relevant to IPO decisions and timing by discussing the inconsistencies within and among three fields of research (entrepreneurship, finance, and strategy) pertaining to the IPO timing decisions that were reviewed in the previous chapter. The chapter starts with a discussion of the IPO motivations and their conflicting implications for a firm's IPO timing decision. The chapter then addresses the gaps in the literature related to the levels of analysis in entrepreneurship and strategy research with respect to firms' response to uncertainty. Lastly, the review addresses the strategic implications of IPO timing and proposes theories that may address these gaps and conflicts.

3.1 Entrepreneurship Research: Later IPO Timings

The chapter 2 review of IPOs in the entrepreneurship literature shows that IPOs have mainly been studied from the perspective of the lifecycle and the perspective of ownership and control (Bhide, 2000). Both perspectives assume that an IPO takes place sometime during the firm's high growth stage or the final stage of the firm's early development. However, under these two perspectives, the specific timing of the IPO launch is not directly addressed, and the conditions that lead to an IPO choice are somewhat inconsistent. The life cycle approach assumes that an IPO will occur during the later stages of a firm's early development and that firms that launch an IPO will either have reached their high growth phase or have matured and are ready for an IPO launch. The assumption ignores two issues: the external market conditions surrounding the firm and the fact that

firms may or may not actively seek an IPO. These two issues that have been ignored could help to explain when and why firms launch IPOs.

First, by leaving out the effects of the external market conditions surrounding the firm, the lifecycle approach does not address how the value of launching an IPO may fluctuate. The external conditions surrounding the firm are important in IPO launches because these conditions may determine the success of an IPO—both during the IPO launch and the firm's performance after. The external market conditions that may make an IPO successful may not necessarily occur during a firm's high growth phase: they may occur during the early stages of a firm's development, or may not occur during the high growth phase at all. Thus, the life cycle perspective does not address incidences in which some firms have launched their IPOs prior to their high growth phase, nor does it explain why firms may choose not to launch an IPO.

Second, by leaving out the motivations (other than harvesting) for an IPO launch, the life cycle approach assumes that managers have little role in determining the direction and outcome of the firm. However, even if the IPO launch is motivated purely by harvesting reasons, the life cycle approach still does not explain why some firms harvest early, some late, and some not at all. That the lifecycle approach does not explain these discrepancies suggests that IPO launches could also be driven by other motives that may explain differences in firms' IPO timing.

Therefore, consideration of other potential IPO motives in conjunction with examining the external market conditions may help explain discrepancies in IPO timings among firms. This is in accordance with many recent strategy and entrepreneurship

researchers who have criticized the life cycle approach as insufficient to explain firm development (Whetten, 1987; Ireland, Hitt, Camp, and Sexton, 2001).

The perspective of ownership and control assumes that firms will defer their IPOs as long as possible. This is based on the assumption that many entrepreneurs have a psychological commitment to the firm they have built and are identified with it (Bhide, 2000). Thus, the perspective of ownership and control assumes that entrepreneurs' preference would be to not launch an IPO or defer it as long as possible. However, this assumption ignores the fact that IPOs may provide firms with competitive advantages, and that the entrepreneurs' desire to succeed through gaining advantages over the competition may mitigate or override any advantages or psychological benefits from prolonged retention of the firm. In the previous chapter, I reviewed how IPOs can provide firms with resources that owners may not have such as economies of scale, marketing and publicity, and quality labor. These resources are essential to entrepreneurs, particularly as research has shown that many entrepreneurs have the qualities to start a firm but lack the skills to manage it to grow and become a large corporation (Bhide, 2000).

While there have been few direct tests of whether entrepreneurs actively seek resources to support their firms' competitiveness, large corporations do respond to changes in their environment and competition (Chen, 1996; Porter, 1985). Research has also shown that entrepreneurs do have open-minded qualities and may be willing to revise their mental models and forecasts when faced with uncertainty (Bhide, 2000). Therefore, changes in the environment and threats from competition may trigger entrepreneurs to reconsider their stance on maintaining ownership and control. Thus, opportunities related to changes in the

external environment and threats from competition are factors that may help explain IPO decisions and deserve testing.

In summary, the entrepreneurship literature suggests that IPO launches are likely to be deferred to as long as possible. However, this perspective does not incorporate the change in the value of the IPO that could occur due to changes in market conditions. Nor does it explore how entrepreneurs may react when competition is present. Understanding how entrepreneurs behave in the presence of opportunities in the external environment and of competition may provide arguments counter to the current assumption.

3.2 Finance Research: Early IPO Timings

As indicated by the review of IPOs in the finance literature in the previous chapter, the literature mainly focuses on IPOs as a wealth creation process (e.g., Myers and Majluf, 1984; Pagano, Panetta, and Zingales, 1998). Wealth creation is defined as (1) the ability to generate wealth through capital raised, and (2) the ability to generate firm growth through sales and profits that significantly exceed competitors' growth (Ireland, Hitt, Camp, and Sexton, 2001). Thus the wealth creation process is the act of raising capital and achieving sales and profitability. Research in finance has mainly focused on the investors' perspective and, as a result, has emphasized the process of raising capital. However, the process of achieving sales has more resonance with entrepreneurs, who may aspire long-term growth of their firm. Thus, the literature ignores that fact that investors and firm owners may place different emphasis on, and have different opportunity costs, in their wealth creation. These different values and opportunity costs may influence decisions and their time horizons in decision making.

Investors will try to recover their investments as early as possible, in order to achieve real returns on investments and reinvest their funding (e.g., Subrahmanyam and Titman, 1999). However, owners that seek firm growth through sales are likely to place more emphasis on taking advantage of opportunities in the market and building competencies for their firm. The ability to achieve sales growth depends not on the capital market, but on the conditions in the product market. Similarly, the need to build competencies depends not on the capital markets, but on the level of competition in the product market. Thus, owners who seek growth through sales are likely to have different time horizons in their IPO decisions than those of investors. Integrating the product market conditions and competition into the study of IPOs will help complete our understanding of IPOs as a wealth creation process.

In summary, the finance literature suggests that early timing of IPOs is preferred. However, the literature takes the perspective of wealth creation for investors, and gives little attention to the firm's perspective of wealth creation for the firm. The ability of firms to gain wealth may also depend on the conditions and the level of competition in the product market. Including this latter perspective into studies on IPOs is essential to our understanding of entrepreneurs' choice and timing of IPO.

3.3 Strategy Research: Unclear on IPO Timings

Research on strategy in general focuses on managing growth and building competitive advantage. The review of IPOs in the previous chapter shows that IPOs can provide firms with growth prospects and competitive advantages. However there has been little research into strategy that directly addresses of the choice of an IPO and the resultant launch timing. Most of the research on IPOs that provides suggestions on IPO launch

timing has followed the finance literature that favors an early launch (i.e., Stuart, Hoang, and Hybels, 1999). Other research on IPO strategy has focused on attaining high market valuations or minimizing underpricing (e.g., Gulati and Higgins, 2003; Cyr, Johnson, and Welbourne, 2000). Again, such research takes the perspective of wealth creation for investors in which high market valuations or low levels of underpricing is favorable.

However, these assumptions do not align with general research in strategy because, as described in the previous section, cashing out or attaining high valuation is not the same as gaining or building competitive advantage for a firm. This is evident because many successful IPO launches experience long-term underperformance (Fischer and Pollock, 2004; Jain and Kini, 2000). As building a competitive advantage depends on the unique resources that a firm possesses or acquires and decision making under uncertainty, it is important that these two factors are integrated into the studies of IPO as a competitive strategy.

The issue of resource acquisition and decision making under uncertainty is likely to affect the timing of firms' IPO launch, but the direction can bring about tensions in predicting the timing of an IPO. First, the need for resources is likely to support early IPO timing, whereas the effect of uncertainty on decision making is unclear. As discussed earlier, IPOs can support firms with economies of scale in production, reputation and legitimacy, network effects, and development of organizational capabilities (Lieberman and Montgomery, 1988). With the presence of competition, early gaining of resources is likely to be advantageous as firms will be able to preempt their rivals (e.g., Lieberman and Montgomery, 1988; Chen, 1996). Research has shown that uncertainties can both induce action (Aldrich and Zimmer, 1996) and induce firms to defer action (McDonald and Siegel,

1996). Therefore, whether uncertainty will induce entrepreneurial firms to launch IPOs or inhibit their IPO launch is unclear and deserves further research.

In summary, the strategy literature has predominantly taken the perspective of the finance literature, which researches IPOs from the perspective of the investor; key aspects of competitive strategy—resource acquisition and decisions under uncertainty—have been ignored. How firms make decisions regarding their IPOs when considering resource acquisition through an IPO under uncertainty is unclear.

3.4 The Behavior and Decision Making Process Under Uncertainty

3.4.1 Behavior Under Uncertainty: Unclear

As discussed in the previous section, uncertainty may play an important role in determining the timing of IPOs. The issue of uncertainty has been studied extensively in the field of strategy and entrepreneurship, but the studies have been inconclusive with respect to the effects on firm behavior, which has remained an open issue in strategy research (Miner and Raju, 2004). Much of the tensions surrounding uncertainty result from whether firms act in accordance with the theory of entrepreneurial action or real options reasoning. In this research, I analyze how firms make their IPO timing decisions based on what the theories of entrepreneurial action or real options reasoning would predict. According to the entrepreneurial action approach, uncertainty increases the range of opportunities available and entrepreneurs who are able to recognize these opportunities will benefit from taking action under uncertainty (Schumpeter, 1934; Shane and Venkataraman, 2000). According to this approach, when uncertainty is high, firms will likely launch an IPO in order to gain funding to support the available opportunities in the market. Conversely, from a real options reasoning approach, the inability to understand the

appropriate response under uncertainty may be managed through deferral (McDonald and Siegel, 1986; Bowman and Hurry, 1993), and firms will likely defer their IPO in order to wait and gain a better understanding of the market opportunities. Thus, these two theories predict opposite outcomes from uncertainty with respect to an IPO launch.

There are indications that these differences may lie in the level of analysis: research under entrepreneurial action has mostly been tested on small firms, whereas research using real options reasoning has mostly been tested on large established firms. Thus, it is important to examine how entrepreneurial firms at different levels of familiarity of the environment respond to uncertainty. That both small firms and large established ones are determining their IPO launch timing provides a unique circumstance that may shed light on the conditions that lead to the different outcomes pertaining to uncertainty.

Beside the potential tensions that derive from uncertain conditions in the market, according to the behavior theory, actions mainly occur when triggered or induced by sudden unexpected shocks in the environment (Kogut, 1991; Lant and Mezias, 1992). As sudden shocks and uncertainty are not mutually exclusive, entrepreneurs may respond to uncertainty, to rapid shifts, or to both, and this deserves further attention.

3.4.2 Response to Different Sources of Uncertainty: Unclear

How entrepreneurs respond to different sources of uncertainty in their IPO launch is unclear. Chapter 2 established the importance of and relationship between product and stock markets. However, whether there is a direct linkage between the product market and firms' decisions on IPO timing has yet to be tested. This raises the question, if such linkage exists, whether firms respond to uncertainty in the product market and stock market in a similar fashion.

The product market and financial market are not entirely correlated. This is because the changes in the product market as a result of consumer preferences, production capability, or manufacturing knowledge may not move in the same direction as the changes in the stock market as a result of political factors, technology factors, or firm-specific advantages. When the changes in the product and stock markets are not in the same direction, tensions in decision making may occur. Some literature suggests that tensions may exist even if these markets move in the same direction. First, entrepreneurs may have different decision making mechanisms when faced with different sources of uncertainty (Busenitz and Barney, 1994). In the stock market, a wealth of information is available to decision makers; thus, firm decisions are likely to be made based on rationality. However, in the product market, where information may not be widely available, firm decisions are likely to be based on bounded rationality. These different decision making heuristics in response to the different sources of uncertainty may lead to different firm decisions (Dess and Beard, 1984). Thus, whether differences in firms' responses to uncertainty in the financial market and product market, especially at the entrepreneurial level, lead to different responses in the pursuit of growth through an IPO deserves examination.

Second, in addition to rationality, the level of familiarity with the conditions in the market may also affect how firms respond to uncertainty. According to Barringer and Bluedorn (1999), managers who are familiar with the external environment will be better able to detect information that may be pertinent to reducing the overall uncertainties that they face, resulting in the ability to make correct decisions (Jackson and Dutton, 1988; Barringer and Bluedorn, 1999). However, firm owners and their venture capitalists, who may have voting rights in the IPO decision, likely have different degrees of familiarity with

each source of uncertainty. Therefore it is important to understand how the different sources of uncertainty may affect the joint decision making about the IPO.

3.5 The Role of Competition: Unclear

The issue of how firms achieve growth and competitive positioning has been a central concern of strategy implementation (e.g., Chandler, 1962; Hamel and Prahalad, 1994). As IPOs can have competitive implications for a firm (as per section 2.3.3), research on how firms react or respond to competitive threats in their IPO decision deserves attention. Surprisingly, research on IPOs in strategy or entrepreneurship has not addressed this issue directly, and research in finance on this issue has been inconclusive. Some researchers have suggested that competition may induce firms to take preemptive moves in acquiring resources (Lieberman and Montgomery, 1988; Chen, 1996); other researchers, especially from the finance literature, have suggested that the presence of competition may induce firms to refrain from launching IPOs (Draho, 2004). Neither view has been tested and the differences may lie in the how competition in the product market and in the stock market has been studied in the different fields.

Competition in the product market has often been studied in the context of using resources to exploit opportunities in order to gain a sustainable advantage over prolonged periods. In comparison, competition in the stock market has often been studied in the context of IPO valuation during the IPO launch period. Although there may be some differences in the contexts of competition in the product market and in the stock market (as discussed in the previous section) product market and stock market decisions are not independent and a conceptual integration in these two areas is merited.

In integrating these two concepts, the notion of blind spots and competitive response may provide a link. Blind spots are defined as judgment mistakes due to "the inability to sufficiently consider the decisions of competitive others" (Zajac and Bazerman, 1991). Competitive responses are how firms respond to potential competition. The literature has shown that, under high levels of competition, firms may either take action to defer the ability of others to act, or they may prefer to not take action in order to avoid triggering potential competitive responses. In the product market, blind spots may allow firms to act to deter competitors from developing competitive advantages. However, given the transparent nature of the IPO process, blind spots may cease to exist. Whether firms take action to deter or avoid rivals in their IPO process needs to be determined. These differences in the nature of the product market and stock market, and how they may integrate and lead to an IPO decision, have been ignored.

3.6 Summary

The literature regarding the timing of IPO launches provides several conflicting opinions. One conflict is from the stand point of how firms react when faced with uncertainty (entrepreneurial action vs. real options reasoning); another is whether firms respond to different sources of uncertainty and competition differently (product market vs. stock market); and a third is whether firms act in accordance with continuous or punctuated models of time.

Several of the conflicts arise from using different theories to explain IPOs from different standpoints (investors' or owners') and different motivations (cash-out or firm growth). This has resulted in inconsistent implications for IPO timing. The strategy literature indicates that little research has been done that directly addresses the choice of

IPO and the resultant IPO timing. Some theories may provide insights to this question—but with opposite predictions for outcomes. The literature on the entrepreneurial action approach states that uncertain market conditions provide firms with entrepreneurial opportunities and may influence an early IPO timing. These opportunities may arise from changes in both the product market and stock market—and the multidimensional influence of such factors have previously been ignored. Conversely, the literature on real options reasoning indicates that firms may not know the appropriate response options to such changes and may choose to defer an IPO. Such differences may hinge on the joint decision-making mechanism of the entrepreneurs and their venture capitalists, as well as the competitive dynamics in the market. Thus, integrating the entrepreneurial action approach and real options reasoning, and the competitive dynamics of the firms under such conditions, may help us understand how firms determine their IPO timing when seeking long-term growth. In addition, the strategy literature indicates that firms typically take action based on a continuous time flow; firm actions are based not on cycles or information in the past, but on current or anticipated events. Some entrepreneurship literature indicates that firms' actions are characterized by periods of market efficiency and are punctuated by periods of upheaval discontinuous shocks. Understanding how shocks impact IPO decisions will increase our understandings of how these decisions are made.

In the next chapter, I develop testable hypotheses related to the gaps and conflicts mentioned above, to explain how and when entrepreneurs choose to launch their IPO based on strategic considerations in the stock market and product market.

CHAPTER 4: THEORIES AND HYPOTHESES

This chapter builds on the gaps and concepts identified in the previous chapter and develops hypotheses to explain how strategic considerations influence firms' IPO timing. The hypotheses proposed in this chapter intend to improve our understanding of IPOs by proposing and testing the relationship between product market and stock market uncertainty and the likelihood of IPOs.

In section 4.1, I propose hypotheses based on the theory of entrepreneurial action, and in section 4.2, I propose competing hypotheses based on the theory of real options reasoning. I then reconcile these two contrasting set of hypotheses in section 4.3, based on the involvement of the venture capitalist in the decision making. Next, in section 4.4, I include competitive factors in the relationship, and in section 4.5, the potential interaction effects between uncertainty and competition. In section 4.6, I test the IPO timing based on a punctuated time flow. And lastly, in section 4.7, I summarize the hypotheses.

4.1 Uncertainty and IPO Timing: A Theory of Entrepreneurial Action

The presence of uncertainty in the external market causes fragmentation of information resulting in market disequilibrium (Hayek, 1937). Such disequilibrium can create tensions about how firms manage uncertainty. This section will discuss how uncertainty influences the higher likelihood of IPO based on the theory of entrepreneurial action. The next section will discuss how uncertainty may act as a deterrent, decreasing the likelihood of IPO, based on the theory of real options reasoning.

The theory of entrepreneurial action is based on taking advantage of the uncertainty in the general environment in order to create firm wealth (e.g., Grimm, Lee, and Smith, 2007; Casson, 1982). According to the theory of entrepreneurial action, uncertainty creates asymmetries of information within the market, which will give rise to disequilibrium in the market. Market disequilibrium will provide opportunities for entrepreneurs to create wealth for the firm (Aldrich and Zimmer, 1986; Busenitz and Barney, 1997). Uncertainty is a necessary condition for entrepreneurial opportunities because if market conditions were certain, information would be equally available to all firms and any rents available would be driven to zero (Casson, 1982). Thus, entrepreneurs who take action when opportunities arise from uncertainty will be able to support their firm's growth.

When entrepreneurs act under uncertain conditions in the general environment, downside risks may also exist. However, entrepreneurs are likely to take action without regard to the potential downside because of the nature of their ability to recognize opportunities and their high tolerance for ambiguity or low aversion to uncertainty. Barringer and Bluedorn (1999) note that entrepreneurs have unique scanning abilities that provide them with skills in detecting information or opportunities that may be pertinent to their firms. And Bhide (2000) noted that entrepreneurs have a high tolerance for ambiguity in making decisions. This quality derives from entrepreneurs' high self-confidence and the low weight they place on the social and psychological consequences of failure. These two traits support firms acting in accordance with the theory of entrepreneurial action, which holds that the presence of uncertainty will likely induce firms to take action to create wealth.

The linkage between uncertainty and taking action to acquire the opportunities inherent in the general environment may extend to IPO launches as well because (1) IPOs provide firms with resources to support the opportunities that may derive from uncertainty in the general environment, and (2) high levels of uncertainty signal entrepreneurs that they may be able to extend their resource base through an IPO.

First, small firms have limited resources to develop their growth. As new demands and opportunities develop as a result of uncertainty, firms may require large increases in economies of scale in production, awareness and legitimacy, and, most importantly, newer sources of supply or raw materials (Shane and Venkataraman, 2000; Ripsas, 1998; Schumpeter, 1934). Many of these requirements may exceed a firm's current capacity and resource base. Also, many small firms are not likely to have a track record of large sales, which limits their borrowing capabilities. Therefore, when the degree of uncertainty becomes very large, firms will need to launch an IPO to gain the resources to support their growth needs.

Second, uncertainty may induce firms to carefully assess the growth opportunities prevalent in the market and the level of competencies that they posses in order to take advantage of these growth opportunities through an IPO. This is because firms may not have recognized their capabilities or their need to develop capabilities (Bowman and Hurry, 1993). However, at high levels of uncertainty, the possible range of product demands and prices will increase, which in turn will enhance the visibility of growth opportunities. Therefore, as the level of uncertainty increases, firms may increase their estimates of their potential growth opportunities and extend their reach to gain them through an IPO. This is

because entrepreneurs will determine the potential course of action needed to exploit the growth opportunities (Bowman and Hurry, 1993).

The timing of a firm's acquisition of resources must also coincide with the entrepreneurial opportunities as a result of high levels of uncertainty in the general environment. When slack resources are acquired and deployed is important because if firms wait too long to act or wait for the level of uncertainty in the general environment to settle, the level of growth opportunities in the market may decline, resulting in missed opportunities or decreased chances of success. Uncertainty that enhances opportunity can originate from both the product market and the stock market.

4.1.1 Product Market Uncertainty

The level of uncertainty in product demand provides a direct indication of the entrepreneurial opportunities that can be acquired through an IPO launch. This is because the level of product demand impacts the price of products, which largely determines the profit a firm may gain. The level of product demand also provides information on how increased demands or new market opportunities can be served, how production processes can be improved, and/or how resources can be allocated. Under conditions of uncertainty in product demand, firms that exploit entrepreneurial opportunities will be able to achieve further growth. However, support of such entrepreneurial opportunities requires critical resources such as funding, human resources, knowledge, and legitimacy (e.g., Ritter and Welch, 2002)—which an IPO launch can provide to young entrepreneurial firms. In addition, in the process of a launch, IPOs can also attract valuable customers and partners (Draho, 2004) and increase publicity (Ravasi and Marchisio, 2003; Rydqvist and Hogholm, 1995)—all necessary to reinforce the success of entrepreneurial actions. Therefore, the

higher the uncertainty in product demand, as signaled by patterns or variances in that demand, the higher the likelihood that firms will launch their IPO. Thus,

HYPOTHESIS 1A: *High uncertainty in product demand will increase the likelihood of IPO launch.*

4.1.2 Stock Market Uncertainty

The level of uncertainty in stock returns also provides an indication of the entrepreneurial opportunities that can be acquired through an IPO launch. This is because the level of stock returns provides an indication of the political climate, resources, knowledge and technological advances, as well as any other changes that may affect the industry. For example, new government policies on import tariffs or industrial zoning could change a firm's ability to achieve high revenues or expand production, resulting in changed growth opportunities, and thereby change investors' sentiment and affect the level of stock returns. These factors, under uncertain conditions, provide entrepreneurial opportunities that may differ from those generated by uncertainty in product demands. In addition, the stock market may be a more efficient indicator of the available entrepreneurial opportunities than the product market, as the stock market enhances transparency and efficient dissemination of information. For new markets, some information may be proprietary and not evident through the product market. Given these differences, the stock market may provide a better indicator of entrepreneurial opportunities than the product market. Therefore, the higher the uncertainty in stock returns, as signaled by patterns or variances in the stock return, the higher the likelihood that firms will launch their IPO. Thus,

HYPOTHESIS 1B: *High uncertainty in stock market return will increase the likelihood of IPO launch.*

4.2 Uncertainty and IPO Timing: A Theory of Real Options Reasoning

While in the previous section, I explained that firms will act in accordance with the theory of entrepreneurial action and have a higher likelihood of IPO launch when uncertainty increases, in this section I develop arguments that firms will act in accordance with the theory of real options reasoning and have a lower likelihood of IPO launch when uncertainty increases. The concept of real options reasoning is an extension of financial option theory, which can be broadly defined as "the right, but not the obligation to take an action in the future" (Amran and Kulatilika, 1999). In using the theory of real options reasoning to understand why firms would have a lower likelihood of IPO, I am defining a firm as an entity that can launch an IPO at any time, but holds the option to defer such launch. The theory of real options reasoning helps to explain an asymmetrical performance distribution that is skewed toward the upside (McGrath, Ferrier, and Mendelow, 2004). Value is achieved when managers pursue opportunities that allow them to enhance their upside potential and contain downside loss. By deferring major action while maintaining the right to pursue action subsequently, firms can pursue high variance outcomes at a later time (McGrath, 1999; McDonald and Siegel, 1986; Dixit and Pindyck, 1994).

As described in the previous section, uncertainty in the external market creates entrepreneurial opportunities. However, at the same time, there exists a potential loss because firms may misinterpret the market and overinvest, resulting in destruction of value. Undertaking major action or investments under a high level of uncertainty could lead to costly mistakes. These mistakes may be due to the firm's inability to assess the environment, to assess the impact of the environment on the firm, or to determine the appropriate responses to take. Thus, the higher the level of uncertainty, the higher the value

of deferring the action due to the potential availability later of better information about the environment, the cause-effect of the environment, and/or the appropriate response option that would allow the firm to avoid costly mistakes (McDonald and Siegel, 1986; Majd and Pindyck, 1987).

Conversely, as the level of uncertainty decreases, the value of deferring an action decreases, and firms stands to gain from taking action with better-informed decisions (Bowman and Hurry, 1993). In the context of IPO timing, firms can defer their IPO until uncertainty in the market subsides. If uncertainty in the market conditions is high or market conditions remain unfavorable, the firm can protect itself against downside losses or costly mistakes by continuing to defer its IPO.

4.2.1 Product Market Uncertainty

Under conditions of high uncertainty in the product market, firms may have difficulty projecting their potential sales and profit (Bergh, 1998). The inability to assess product demand may lead to the inability to accurately determine the pricing and the required resources for production planning. Without the ability to predict these factors, firms will find it difficult to determine the production needs, staffing, and marketing of their products. Launching an IPO under highly uncertain demand conditions in order to acquire resources and capabilities to support production may incur opportunity costs for huge investments in production activities (Kulatilaka and Perotti, 1998; Folta and O'Brien, 2004).

Although firms may launch an IPO during high levels of uncertainty in order to acquire capital first, then acquire the necessary resources for production when uncertainty subsides, research has found that premature acquisition does not confer advantages on a

firm. For resources to have value, they must be exploited by taking market actions (Grimm, Lee, and Smith, 2006). In addition, firms that acquire resources without considering demand may acquire the wrong resources (Lieberman and Montgomery, 1998), resulting in inefficient resource deployment (Penrose, 1959) and suboptimal behavior (March and Simon, 1958). These combined effects may deter the growth of the firm (Wiseman and Bromiley, 1996)—which contravenes the objective for launching an IPO. Therefore, assuming there is a low level of understanding of the product market demand trends, future production requirements, and capital expenditure needs, delaying an IPO launch allows firms to learn more about their optimal course of action prior to obtaining the capital for resource acquisition (Jovanovic and Rousseau, 2001). In addition to minimizing opportunity costs, delaying an IPO launch also provides firms with the opportunity to free ride on the market development that early movers endure the costs and risks of promoting (Wernerfelt and Karnani, 1987; Liu, 2005). Therefore, the higher the uncertainty in product demand, as signaled by patterns or variances in the product demand, the lower the likelihood that firms will launch their IPO. Thus,

HYPOTHESIS 2A: *High uncertainty in product demand will decrease the likelihood of IPO launch.*

4.2.2 Stock Market Uncertainty

Similar to product demand uncertainty, uncertainty in the stock market can lead to a lower likelihood of IPO launch. While firms' actions under product uncertainty hinge upon firm productivity and opportunity costs within the product demand market, their actions under stock market uncertainty hinge on the effective acquisition of capital and the opportunity costs within the stock market. Highly volatile and unpredictable stock market returns may make it difficult for firms to accurately predict the costs required to purchase

capital from the market—which is one requirement of successful IPO performance. Launching an IPO without being able to predict the costs required to purchase capital may lead to higher marketing costs for the firm in going public and reduced growth opportunities. Under uncertain stock market conditions, firms must make significant investments in IPO market development in order to secure a successful launch (Benveniste, Busaba, and Wilhelm, 2002). This entails not only developing the market for themselves, but also in effect developing the stock market for the IPO launches of other firms during the same or a subsequent period. By having to pay higher costs to obtain capital, firms risk reducing the value of their potential growth opportunities in later periods (Jou, 2001). Therefore, under conditions of high uncertainty in the stock market, as signaled by patterns or variances in the stock return, delaying an IPO launch will allow firms to wait for free information, for the IPO market to be developed by other firms (Benveniste, Busaba, and Wilhelm, 2002), and/or for the opportunity to gain price run-ups (Ritter, 1991; Lerner, 1994; Benveniste, Busaba, and Wilhelm, 2002). Thus,

HYPOTHESIS 2B: *High uncertainty in stock return will decrease the likelihood of IPO launch.*

4.2.3 Irreversibility and Uncertainty

The irreversibility of a major action is a condition that necessarily provides value to deferral: the higher the degree of irreversibility of an action, the higher the value of deferring it (Dixit and Pindyck, 1994). If actions are fully reversible, there is no need to defer them, as full recovery will be possible from any missteps taken. The costs of reversing action can be categorized into the cost of reversing tangible investments and the cost of reversing effects of intangible action. Research on real options has emphasized the

costs of the tangible investment component of irreversibility, such as capital expenses or other costs that can be subject to investment write-offs. However, when the investment is intangible, or is integrated within the firm, the costs can be substantial and may not be recoverable. Meyer and Rowan (1977) note that formal structures and rules developed by a firm can be binding on it. Thus, the irreversibility of a binding action will probably have a significant impact on the firm's likelihood of taking action.

Researchers have mainly ignored IPOs as an irreversible action for two reasons: the low costs of listing, and the ability of public firms to "go private." First, the cost of being a public firm can be regarded as minimal when compared to the potential capital to be raised through an IPO. Benninga, Helmantel, and Sarig (2005) estimated that the average direct cost of being a publicly traded firm is about 10% of firm profits as of the IPO launch date. Other researchers have found the cost of maintaining the current IPO status and the direct costs of delisting to be insignificant (Macey, O'Hara, and Pompila, 2003; Chen, Guo, and Lin, 2005). Given such minimal sunk costs, firms may not consider IPOs as irreversible action. Second, public firms have reverted their status to private. Loughran and Ritter (1995) found that the rate of IPO firms going private during the 1980s was about 7%, while Welch (1999) indicates that this rate during the 1980s to mid-1990s was approximately 13%.

While these studies imply that an IPO launch may, to a certain extent, be reversed, they ignore the intangible components that may affect the process of considering to launch an IPO. Evidence from the literature on public firms going private suggests that the process may not be so simple and that there may differences among firms in their ability to reverse their IPO decision. First, the decision to go private may not be available to all firms. The

anti-takeover statute prohibits management buyouts in certain industries. Also, firms may be in an industry that lacks the cash flows necessary for a management buyout (MBO) or leveraged buyout (LBO)—the processes that takes a firm private. Second, going private can be costly. Firms can only delist themselves from the stock exchange when they have a small shareholder base that no longer justifies the imposition of public company obligations and rules imposed by the Securities Exchange Commission (SEC). In most cases, in order to go private, firms will have to repurchase their shares from their shareholders. This process may leave management prone to litigation if stockholders question the fairness of the price offered for their shares. Thus, management may have to pay a high price for repurchasing shares in order to avoid litigation by stockholders.

Third, the process of going private can be time-consuming and distracting to management. The uncertainty of the outcome of going private may disconnect staff, customers, suppliers, and key stakeholders from the firm. Fourth, the notion of failure and regret may be intense for entrepreneurs that are highly vested and emotionally attached to their firms (Bhide, 2000; Markman, Baron, and Balkin, 2005). Therefore the higher the level of irreversibility, the greater the negative aspects of launching an IPO under uncertainty.

The interaction between uncertainty and irreversibility, rather than the direct effect of irreversibility, is a necessary condition for deferral. This is because for a deferral to occur, uncertainty must exist; without uncertainty, there is no value in waiting. Also, without uncertainty, the level of irreversibility is likely to have little effect as the ex ante outcome is known to decision makers prior to taking action. Given that irreversibility is a concept unique to the option of deferral, irreversibility will likely further defer the course

of an IPO for firms that act in accordance with real options reasoning, but will have no effect for firms acting in accordance with entrepreneurial actions. Thus,

HYPOTHESIS 3A: *High levels of irreversibility will increase the negative relationship between product demand uncertainty and the likelihood of IPO launch.*

HYPOTHESIS 3B: *High levels of irreversibility will increase the negative relationship between stock return uncertainty and the likelihood of IPO launch.*

As irreversibility is a concept unique to deferral options, and will likely have no effect for firms undertaking the entrepreneurial approach, hypotheses were generated between uncertainty, irreversibility, and IPO only in this section and not in the previous one.

4.3 Uncertainty and IPO Timing: The Effects of Venture Capitalist Involvement

The sets of competing hypotheses presented in section 4.1 and 4.2 are based on two different theories: the theory of entrepreneurial action and the theory of real options reasoning. Such contrasting differences in the effect of uncertainty on the likelihood of IPO may be due to the degree of influence the venture capitalist has on the entrepreneur's decisions. Firms with entrepreneurial orientation have been characterized and distinguished from more established firms by the former's ability to make key decisions independently and pursue entrepreneurial opportunities accordingly (Lumpkin and Dess, 1996). In the context of IPOs, the level of venture capitalists involvement in a firm may vary according to the level of their investment, ranging from very limited involvement to total control over key decisions in management, including the IPO timing (MacMillan et al., 1989; Zider, 1998).

Firms that have less influence from venture capitalists in pursuing their entrepreneurial opportunities are likely to maintain an entrepreneurial action approach in

their IPO timing decisions—i.e., uncertain conditions will likely induce firms to launch their IPO earlier. This is because firms will be able to take full advantage of asymmetries of information in order to a gain advantage over their competition.

However, firms that have made decisions with the involvement of venture capitalists are likely to act in accordance with the theory of real options reasoning due to the inherent nature of rational decision making that venture capitalists are likely to possess. This is because venture capitalists are likely to have lower levels of entrepreneurial orientation and to have strong incentives to avoid mistakes in their investments. First, venture capitalists' support for firms in making decisions is based on the venture capitalists' experience with other entrepreneurs and they leverage their network of shared information (Barry, Muscarella, Peavy, and Vetsupens, 1990; Schultz, 2000). Over time, venture capitalists are able to learn from mistakes that young firms frequently make under uncertain conditions (Pagano and Röell, 1998). Such experience is likely to guide decision making under uncertainty toward a more rational approach. Second, venture capitalists who undertake an IPO launch under high levels of uncertainty may be prone to making costly mistakes that lower returns on investments and can tarnish the venture capitalists' reputation. Therefore, firms with low levels of venture capitalist involvement are likely to take an entrepreneurial action approach in their IPO timing decisions, whereas firms with high levels of venture capitalist involvement are likely to act in accordance with a real options reasoning approach in their IPO timing decisions. Thus,

HYPOTHESIS 4: *Uncertainty will positively influence the likelihood of IPO when firms have a low level of venture capitalist involvement and negatively influence the likelihood of IPO when firms have a high level of venture capitalist involvement in their decision making.*

4.4 The Direct Effects of Competition on the Likelihood IPO

Beside competing predictions about the impact of uncertainty on the likelihood of IPOs, the potential strategic value from an IPO launch also hinges on the competitive dynamics in both the product market and the IPO offerings market. This is because firms incorporate the potential actions of their rivals into their own decisions. In the context of the product market, although firms in the same industry may offer different products, they are likely to have market commonalities and resource similarities: the resources, capabilities, and technology needed to develop their growth trajectory will be somewhat related. Chen (1996) noted that firms that have market commonalities and resource similarities will have a high awareness of their competitive environment. Thus, such firms will take into consideration their rivals' actions and potential reactions in response to their own firm's actions. Under low levels of competition, firms are highly likely to avoid rivalry because the competition may escalate to a point that no firms would be better off (Grimm, Lee, and Smith, 2006). Thus, actions may be delayed due to skepticism about what the firm could gain through market preemption. In the context of potential IPO launches, when rivalry is low in the product market, the prevalent opportunities can be easily observed and resources readily acquired by the competition (Grimm, Lee, and Smith, 2006). Any attempts to launch an IPO to acquire resources and develop capabilities are likely to trigger rivals to follow suit, and any competitive advantage gained can be easily eroded.

However, when there is a high level of competition in the product market, rivals will likely react to tactics in order to defend their critical resource base and their market position (Grimm, Lee, and Smith, 2006). When there is strong competition, firms that do

not launch an IPO may be shut out from gaining resources to pursue their entrepreneurial opportunities. These opportunities may also extend to the ability to gain scale and experience effects, reputation effects, and network effects, and to lead development of organizational capabilities (Lieberman and Montgomery, 1988; Schultz, 2000). By ignoring these benefits, firms may be foregoing the competitive advantages that stem from such growth opportunities and may be allowing others to preempt the market. Thus,

HYPOTHESIS 5A: *High levels of product market competition will increase the likelihood of IPO launch.*

Similar to the effect of competition in the product market, when there are low levels of IPO offerings, firms will likely avoid rivalry in their IPO launch decision. This is because firms that launch an IPO when there are few IPO offerings will provoke attention from other firms of their need to acquire capital resources from investors. Firms that follow prior IPO launches can gain information about investor allocation, pricing strategy, and cost advantages in the IPO launch process. This could place the firms that launched their IPO earlier at a disadvantage in terms of the amount of resources gained.

However, when there are many IPO offerings in the market, firms will launch their IPO early. Firms that delay their IPO may be foregoing the competitive advantages that stem from such growth opportunities, and allow others to preempt the market. As one firm exercises its option to launch an IPO under these conditions, others will be influenced to enter quickly, triggering a bandwagon effect. This effect was evident during the late 1990s, when there were many offerings in the stock market among Internet companies and several Internet companies launched their IPOs early in order to gain early advantages in resource acquisition and capabilities development (Schultz and Zaman, 2001).

In addition to preempting the market for resources, high levels of IPO offerings may induce firms to launch IPOs in order to develop the ability to engage in rivals' potentially predatory tactics (Povel and Raith, 2004). Firms that have high leverage are more likely to behave cautiously and are less aggressive in the product market (Brander and Lewis, 1986; Bolton and Scharfstein, 1990). The inability of firms to take an aggressive stance encourages predatory behavior by rivals, because firms that have substantial amounts of capital or easy access to it can sustain losses until they succeed in eliminating competition in the market (Teslar, 1996; Kanatas and Qi, 2001). Thus,

HYPOTHESIS 5B*: High levels of competition in the IPO offerings market will increase the likelihood of IPO launch.*

4.5 The Moderating Effects of Competition on Likelihood of IPO

Beside the independent effects of uncertainty and competition on the likelihood of IPO launch, the interplay of these components is likely to influence the likelihood of IPO launch. The effects of this interplay may also vary based on the source of uncertainty and the type of competition (product market or stock market) that the firm faces. To examine the interplay between competition and uncertainty, I highlight the moderating role of competition within the product market and the stock market. This premise is based on research that competition is a key factor affecting firms' strategy and decision making under uncertain conditions (Porter, 1980).

Some literature suggests that the presence of competition under uncertainty may induce firms to take action due to two key factors: (1) increased entrepreneurial discovery and recognition, and (2) lowered value of deferral options. First, competition increases firms' ability to discover and recognize opportunities through increased available information and activities. Research has shown that entrepreneurs that have extensive

informal networks (i.e., customers, suppliers, employees of financial institutions) and frequently attend industry-related activities (i.e., conferences, seminars, and workshops) will have heightened knowledge of information within their industry (Ozgen and Baron, 2007). The ability to gain insights into information within the industry through these sources enhances entrepreneurs' alertness to opportunities (Baron, 2006). Such sources of information are likely to be more numerous when there are a large number of firms or rivalries within the same industry. In addition, from an equilibrium economy approach, the presence of competitive action within the same industry provides even more opportunity to observe errors such as the competition's shortages, surplusses, and misallocated resources, thus increasing the level of entrepreneurial activity (Kirzner, 1973).

Second, the presence of competition quickly erodes any deferral options that a firm may hold (Grenadier, 2002; Trigeorgis, 1993). This is because competitive firms seeking to optimize the values of their own holdings will incorporate expectations about moves by the competition and include them in decisions about timing of action (Miller and Folta, 2002). Thus, when the threat of competition exists, despite any prior high values of deferral options derived from high values of uncertainty, firms will take action.

The two factors mentioned above suggest that the presence of competition will moderate the relationship between uncertainty and the likelihood of IPO. However these two factors assume the presence of blind spots. Blind spots exist as a result of "competitors' insufficient consideration of the contingent decisions of their competitive others" (Zajac and Bazerman, 1991). The presence of blind spots allows firms to act without immediate reactions (Grimm, Lee, and Smith, 2006). Hence, with the presence of blind spots, when high levels of uncertainty exist, firms will be able to leverage the

resultant entrepreneurial opportunities and gain competitive advantage. However, if blind spots do not exist, the two factors mentioned above may not hold as any action taken may be quickly matched by competition. The potential response from rivals may deter firms from launching their IPO. The different characteristics of the general environment may represent the existence of blind spots, which may result in different actions under uncertainty and competition.

4.5.1 Product Market

In the descriptions offered in the preceding sections, the entrepreneur ex ante recognizes the opportunities inherent the market, and achieves advantage from the opportunities over time. Entrepreneurs are able to take advantage of such opportunities due to the presence of competitors' blind spots (Grimm, Lee, and Smith, 2006; Zajac and Bazerman, 1991). However, the process of an IPO launch may erode blind spots, thus diminishing the competitive advantage from entrepreneurial activities. This is because the process of launching an IPO requires firms to disclose to investors and the public relevant information necessary for the valuation of the firm, both during the IPO launch period and periodically after it. Such disclosure of firm valuation may subject firms to leakage of confidential information regarding their product strategy and tactics (Chemmanur and Fulghieri, 1999; Subrahmanyam and Titman, 1999). Not only will the process of an IPO launch diminish any entrepreneurial opportunities that a firm may have identified, but it may also place a firm at a competitive disadvantage to both listed and private firms. Thus, such conditions will induce firms to forego any potential opportunities by not launching an IPO. By doing so, firms may forego some entrepreneurial activities, but will be able to sustain their business and avoid confrontation with or retaliation from rivals (Grimm, Lee,

and Smith, 2006). Therefore, under high uncertainty in product market demand, when there are high levels of competition in the product market, launching an IPO early may be disadvantageous. Thus,

> HYPOTHESIS 6A: *The higher the level of product market competition, the level of product demand uncertainty will have a stronger negative effect on the likelihood of IPO launch.*

4.5.2 Stock Market

Contrary to the interplay of product market uncertainty and product market competition, the interplay of stock return uncertainty and competition for funding in the IPO offerings market will likely have a stronger positive effect on the likelihood of IPO launch because (1) the abundance of information regarding the stock market will increase the value of launching an IPO, and (2) the disadvantages of not becoming a public firm will be too great to ignore. First, when there are high levels of competition for funding in the IPO offerings market, substantial levels of information and activities will be available to entrepreneurs contemplating an IPO launch. Information regarding IPO firms' launch process, launch price, and growth opportunities, in general, will be disseminated through various means. This will provide firms with a better understating of their own growth opportunities, which may have been unclear previously (e.g., Dow and Gorton, 1997; Ang, Cole, and Lin, 2000). Also, several actors, such as investment bankers and investors will become more visible and play an important role in disseminating information about the IPO process and the value that firms can gain through an IPO. This will reduce the cost required in launching an IPO, which in effect will increase the value of an IPO launch. Having increased information regarding an IPO launch and the necessary support for it will likely decrease firms' uncertainty in their IPO launch decision. In addition, by waiting too long to

launch an IPO, firms not only risk losing valuable growth opportunities as the growth option values diminishes over time, but also may incur increased expenses due to the need to recreate the IPO activities that they could have piggy-backed on when competition was high.

Second, when the level of growth opportunities and competition for funding in the stock market is high, rivals may take advantage of the market and preempt resources. While some strategic advantages may erode due to leakage (e.g., Chemmanur and Fulghieri, 1999), by waiting too long to launch an IPO, firms may be totally left out of the market. This may not only reduce their ability to compete effectively in the future, but may also induce aggressive behavior from rivals (e.g., Fudenburg and Tirole, 1986).

Therefore, the above two reasons combined suggest that under high levels of uncertainty and competition in the stock market, firms are likely to be motivated to launch their IPOs. Thus,

> HYPOTHESIS 6B: *The higher the level of competition in the IPO offerings market, the level of stock uncertainty will have a stronger positive effect on the likelihood of IPO launch.*

Table 6 summarizes the theories of firm actions and strategic considerations in the IPO context under a continuous time flow.

4.6 Positive Shock and IPO Timing

Hypotheses 1–6 were offered as if there had not been a discontinuous time flow. However, Schumpeter (1934) noted that periods of market efficiency are punctuated by periods of upheaval due to discontinuous shocks, and that entrepreneurial actions are likely to occur during these periods. This punctuated time flow approach follows the notion that entrepreneurs use benchmarks or long-term growth trends as references, and take action

when there is a high deviation from the benchmark or trends. This perspective contrasts with hypotheses 1–6 in noting that entrepreneurs are more likely to act when there is information of high relevance that is disconnected from the past. Early work on firms' actions in accordance with a punctuated time flow include that of Kogut (1991), who found that sudden increases in short-term profit rates induces firms to take action, and Lant and Mezias (1992), who found that changes in the fundamentals of the environment increase the likelihood of significant organizational change. (Table 7 summarizes the continuous time flow and punctuated time flow with respect to IPO decisions).

The use of benchmarks or references in taking action is supported by research in decision making. In decision-making theory, individuals may not have the ability to detect or assess opportunities, and thus they rely on only a few cues from available information when making decisions (Hitt and Tyler, 1991; Camerer, 1981). If there are no formal contracts or indicators of the value of going public, the IPO launch will likely be triggered by cues in the product market and stock market that signal a rise in the value to be gained from the launch relative to long-term market trends.

In the context of the product market, Porter (1980) noted that when firms anticipate an increase in product demand, capacity expansion in production will become a game of preemption. For preemption to succeed, firms must move earlier than their competitors in securing the resources for production and entering the market (Lieberman and Montgomery, 1988), and they must make sure that they are not preempted by their rivals. Therefore, firms that face a positive demand shock will likely anticipate large growth potential and will launch an IPO in order to increase their capacity for production and to preempt the market. This corroborates Clementi's (2002) research, which found a high

correlation between firms going public and the degree of required productivity increase. Thus,

HYPOTHESIS 7A: *The higher the increase in the product demand trend, the higher the likelihood of IPO launch.*

Stock market returns of firms in the same or similar industries act as a signal of market growth, investment opportunities, and favorable investor sentiment. As discussed in the previous section, high market growth potential and increased investment opportunities will induce firms to compete in order to secure the resources for production (Lieberman and Montgomery, 1988). Favorable investor sentiment will allow firms to gain access to capital at a cheaper price (Loughran and Ritter, 1995; Rajan and Servaes, 1997; Pagano, Panetta, and Zingales, 1998). Therefore, firms that face a positive shock in stock market valuations in the same or a similar industry will likely anticipate high growth potential and will exercise the option to launch an IPO in order to increase their capacity for production and preempt the market, while taking advantage of cheap funding. Thus,

HYPOTHESIS 7B: *The higher the increase in stock market return trends, the higher the likelihood of IPO launch.*

4.7 Summary

Figures 2 and 3 contain the models of IPO likelihood that provide details of the specific relationships that the hypotheses in this chapter are testing. The models suggest that firms determine the timing of their IPO launch based on their level of venture capitalist involvement, strategic considerations such as product market uncertainty, stock market uncertainty, and competition. Integrating the perspective of entrepreneurial action, real options reasoning, and competitive dynamics, product market and stock market uncertainty

is expected to induce firms to either defer or accelerate the timing of their IPO launch based on the level of the involvement by the venture capitalist. Firms with low levels of venture capitalist involvement take an entrepreneurial action approach, in which the likelihood of an IPO launch increases with the level of uncertainty in the market, whereas firms with high levels of such involvement act in accordance with a real options reasoning approach in which the likelihood of an IPO launch decreases with the level of uncertainty in the market. The likelihood of IPO is also influenced by the level of irreversibility of the IPO decision, competition, and sudden increases in stock market and product demand trends. While irreversibility negatively moderates the likelihood of IPO launch, the effect of moderation by the level of competition on the likelihood of IPO depends on the source and type of competition. Competition in the stock market positively moderates the effect of stock return uncertainty on the likelihood of IPO launch, whereas competition in the product market negatively moderates the effect of product market uncertainty on likelihood of IPO launch.

Chapter 5 provides an overview of the research methods, including sample and research design, operationalization of key variables, and the methods used to test the model.

CHAPTER 5: RESEARCH METHODOLOGY

In this chapter I describe the methodological approach used to test my hypotheses. I begin by providing the details of my data sources and the sample selection process. I also describe the key variables used in analyzing my constructs and the methodology used for testing the hypotheses.

5.1 Sample Design and Data

The sample for this study consists of private US manufacturing firms that were founded from 1980 through 1996. The firms in the sample are firms that had received funding through venture capital firms, mezzanine financing, preferred shares, or some combination thereof. The use of firms that had sought funding through these means ensured that the sample consisted of high growth firms likely to seek an IPO in the future. This is because venture capitalists, investors, or mezzanine finance providers typically seek companies with potential for rapid and substantial growth that will need substantial capital from large investors to finance their growth. Firms with limited products and slower growth are not candidates for such funding and usually fulfill financing from friends or business angels rather than through venture capitalists or mezzanine financing (Smith and Smith, 2004:499). The use of the category of firms selected allowed examination of firm-level attributes such as whether the firms were venture capital-backed or not, and if so, the amount of capital investments received during each stage of growth.

The sample was collected from the SDC Platinum VentureXpert database published by Thompson Financial. The database provides comprehensive information on firms that

have received funding from venture capitalists and mezzanine financers. The database includes information on the sector of the firm, the amount of financing received, the timing and amount of financing, the status of the firm (i.e., private, public, subsidiary, bankrupt, acquired, etc.), and the name of the financers. I tracked data from each sample firm from the time of founding until the end of 1996 and recorded the date the firm went public. For the firms that did not launch an IPO during the sample time period, I noted whether they remained private or ceased operations. Spin-offs, reverse-leverage buyouts, unit offerings, and firms that went bankrupt prior to the founding date were excluded from the sample.[3]

The period after 1996 was not sampled for two reasons. First, after 1996, several firms were subject to the "bubble," and a large number of firms launched IPOs for reasons other than carrying out a competitive strategy. Second, in 1997, the US Census Bureau changed the standard industry classification from the Standard Industrial Classification (SIC) code to the North American Industry Classification System (NAICS) code. The conversion limited my ability to compare time series information for a large number of manufacturing firms before and after 1997.

Other data that complemented this sample were gathered from secondary sources: the Annual Survey of Manufacturers (US Census Bureau), COMPUSTAT, the Center for Research in Security Prices (CRSP), SDC Mergers & Acquisitions, and various company prospectuses and proxy statements.

[3] Such firms were excluded to ensure that all firms in the sample are firms that had past their start-up phase, but were still defined as entrepreneurial, and were not subsidiaries of corporations. Entrepreneurial firms that were eventually acquired or went through a merger and acquisition process were still tracked from the time of establishment until the time that the "hazard" occurred, and were censored at the time of the hazard. Thus, any competing risks that a typical entrepreneurial firm may face were still accounted for in the analysis.

5.2 Key Variables and Measures

5.2.1 Dependent Variable

The dependent variable for Hypotheses 1–7 is the likelihood of the IPO launch. This was measured in terms of the instantaneous risk or event that a firm would go public in any given time interval. The use of the likelihood of IPO as a dependent variable fulfills the research's objective of trying to understand whether an IPO launch would occur early or later. This is because the likelihood of IPO can be regarded as the inverse of the time to IPO; on the average, firms with low likelihoods of IPOs will take longer for their IPO event to occur, whereas firms with high likelihoods of IPOs will take less time for their IPO event to occur.

A hazard model was used to measure the likelihood that an IPO event would occur (see section 5.3.1). A logistic regression was not used to measure the likelihood of IPO as the dependent variable because it ignores information on the timing of the IPO and its time-varying covariates. I also did not employ the length of time between the firm's founding date and the date of its IPO as a dependent variable, because my methodology incorporates the censoring of firms that had not launched an IPO by the end of the study period.

5.2.2 Independent Variables

5.2.1.1 Product Demand Uncertainty and Shock

Product demand uncertainty was measured using the randomness in the annual US value of product shipments taken from the Annual Survey of Manufacturers (US Census Bureau) at the 3–digit level of the SIC classification for the years 1958–1996. First, the value of product shipments for all industries was adjusted to 1980 dollars based on the consumer price index (CPI) in order to account for inflation. Next, the value of product

shipment data was normalized by dividing the shipment value for each year by the value for the year 1980, the first year in the time series for each industry. In other words, the value of shipments for 1980 was set to a benchmark of 100. I then compared the shipment value for each of the remaining years against the 1980 value for that industry. This approach is similar to that used by Kogut (1991) in comparing the value of product demand across time.

In order to measure the randomness in product demand, a generalized auto-regressive conditional heteroskedasticity (GARCH) procedure was used. Previous measures of demand uncertainty have relied mainly on using parameters based on a fixed number of the most recent observations (e.g., Krishnan, Martin, and Noorderhaven, 2006). This assumes equal weights for past parameters and does not account for the possibility of heteroskedasticty across time. In contrast, the GARCH procedure incorporates the weighted average of the long-run average variance prior to the current period based on the calculated past variances, the variance predicted for the current period, and the new information in the current period captured by the most recent squared residual (Engle, 2001). In addition, in the GARCH procedure, although the weighted average of the long-run average variance in the past remains in the model at a declining weight over time, it does not reduce to zero. Thus, the GARCH procedure accounts for the heteroskedasticity of the variance, providing a better measure of the uncertainty that firms face that is not predictable for any trend that might exist at different points of the time series prior to the current period.

Specifically, for this research, a GARCH-M model was employed to calculate the uncertainty of product demand, as it allows for the specification of the number of lags in

the variances that are included in the current variance (Bollerslev, 1986; Engle, 2001; Christoffersen and Jacobs, 2004). The function form used to calculate the demand uncertainty is as follows:

$$y_t = x_t\beta + \gamma\sqrt{h}_t + u\,,$$

where y_t is the value of the product shipments and h_t is the annual conditional error variance generated. Thus, the square root of h_t is the estimate of product demand uncertainty. Residual γ is modeled as

$$u_t = \sqrt{h}_t \cdot v_t,$$

where v_t represents independent, identically distributed random noise with a zero mean and unit variance, and h_t is expressed as

$$h_t = k + \delta_1 h_{t-1} + \delta_2 h_{t-2} + \ldots\ldots + \delta_p h_{t-p} + \alpha_1 u^2_{t-1} + \alpha_2 u^2_{t-2} + \ldots\ldots + \alpha_q u^2_{t-q}\,.$$

Here, p specifies the number of lags for the squared error terms and q specifies the number of variances included in the model. In the IPO timing model, a one-period lag for both parameters was used, as empirical evidence has proven that using small lags for both parameters is sufficient to model the variance over long sample periods (French, Schwert, and Stambaugh, 1987; Franses and Van Dijk, 1996). For each industry, an individual time series was fitted to a GARCH procedure (i.e., for SIC 208, GARCH models were produced for years 1958 to 1980 for the level of uncertainty at 1980, 1958 to 1981 for the level of uncertainty at 1981, 1958 to 1982 for the level of uncertainty at 1982, and so on). This allowed me to approximate the time-varying estimates of uncertainty for each industry at different points of time across the time series of 1980–1996. The level of product demand uncertainty was also calculated at the second power (h) in order to capture any possible

nonlinear effects of product demand uncertainty on the timing of the IPO. The use of a GARCH model to measure product demand uncertainty follows the same use of Folta and O'Brien (2004) on product sales to measure uncertainty.

Similar to the method used in Kogut (1991), product demand shock was also assessed directly from the product shipment data using a measure of the increase in the product demand trend. To do this, I divided the value of the normalized product shipment by the value of the three-year-lagged normalized product shipment. This measure takes the approach that firms make production decisions based on previous demand and look at departures from this trend as a signal to change production capabilities.

5.2.1.2 Stock Return Uncertainty and Shock

In this study, stock return uncertainty was measured using the randomness of monthly stock market returns for firms in the same industry. Lerner (1994b) showed that an industry-specific index is the preferred method of capturing the changes in equity markets, as times of high market returns or valuations vary across industries and are not always in complete alignment with trends in the general market. I used Lerner's methodology to develop stock indexes for each group of industries in the manufacturing firm sample. First, firms' monthly stock market returns were obtained from CRSP for the years 1958–1996 at the SIC 3-digit level. Next, the industry-wide stock market returns were calculated by adding the monthly stock returns of the firms in each industry, weighted by the market capitalization of the individual firms. I then employed a GARCH-M model to measure the uncertainty in the stock market returns. For each industry, I fitted the time-series data using a GARCH procedure, to approximate the time-varying estimates of stock market return uncertainty at different points across the time series. GARCH models are regarded as

appropriate for forecasting volatility in stock market returns, as they remove excess kurtosis in market returns and account for the clustering of volatility in market returns—two unique dimensions of stock market returns (Chong, Ahmad, and Abdullah, 1999). These two characteristics are not accounted for in conventional time-series procedures and econometric models. Similar to the calculations for product demand uncertainty, a second-power test of the stock market return uncertainty was conducted to take into account any possible nonlinear effects of stock market return uncertainty on the IPO timing. Other researchers in the field of strategy who have used the GARCH model on stock returns to measure uncertainty include Wu, Levitas, and Priem (2005).

Stock return shock was measured by comparing the increase in firms' monthly market-to-book ratios against the average market-to-book ratios of firms in the same industry for the preceding 36 months. The intuition is that as there is no long-term trend in market-to-book ratios, firms will compare the current market-to-book ratio against the nearest average benchmark as an indicator of a rise in growth option values. The stock return shock was calculated as follows:

$$SRS_{t,i} = \log (M_{t,i}/B_{t,i}) - \log (M_{t-1 \sim t-36,i}/B_{t-1 \sim t-36,i}),$$

where the stock return shock (*SRS*) is the difference between the current value of the log of the market-to-book ratio ($M_{t,i}/B_{t,i}$) for the i^{th} industry at time t, and the log of the average market-to-book ratio ($M_{t-1 \sim t-12,i}/B_{t-1 \sim t-12,i}$) for the previous 12 months for the i^{th} industry. All data for market-to-book ratios were obtained from the CRSP database on a monthly basis for the years 1977–1996. Other researchers in the field of strategy who have used the increase in market-to-book ratio to measure stock return shock include Arthur (2003).

5.2.1.3 Product Market Competition

The degree of competition in the product market was measured using the Blau index (Blau, 1977), which is the inverse of the Herfindahl index (Blau index = 1 – Herfindahl index). This follows several researchers who have used the Herfindahl index to measure the degree of competition among firms (e.g., Fischer and Pollack, 2002; Douglas and Judge, 2001; Baum and Korn, 1996; Boyd, 1990). The Herfindahl index represents the sum of the squared market shares of all listed firms within a particular industry. Therefore, a higher Blau index (or a lower Herfindahl index) represents a greater presence of competition in the product market. Higher levels of competition create competitive uncertainty because high levels of connectedness between firms within an industry can induce change and disrupt the status quo at any time without notice, producing unanticipated consequences for industry members (Salancik and Pfeffer, 1978).

The data used to calculate the Blau index at the SIC 3-digit level was obtained from two sources: the Herfindahl index from the US Census Bureau and COMPUSTAT Industrial. The advantage of using the US Census Bureau's industry concentration data is that they are a direct measure of the degree of competition at the product level as opposed to the firm level (the firm level could include several different products with different SIC codes). The major disadvantage is that the Herfindahl index is only available every fourth year. Thus, the Herfindahl index based on Census Bureau data does not capture volatility within the four-year interval.

The advantage of using COMPUSTAT Industrial data to calculate the Blau index is that industry information is available annually, thus capturing the volatility at yearly intervals. The disadvantage is that these data are a direct measure of the degree of

competition at the firm level. Thus, the Herfindahl index based on COMPUSTAT data may capture several different levels of products with different SIC codes. However, firms' perception of competition is defined by major lines of business in which the core businesses of firms, even for diversified firms, can become the dominant frame of reference (Porter, 1980; Prahalad and Bettis, 1986). Thus, competition among firms may not be based on one SIC classification, but related SIC classifications, especially when firms achieve economies of scale and produce complementary products. Another disadvantage is that information from COMPUSTAT tends to have a higher proportion of firms that have large sales volumes and firms that have gone public.

5.2.1.4 Competition in the IPO Offerings Market

The degree of competition in the IPO offerings market was measured by using the number of firms in the same industry at the 2-digit SIC code that had launched IPOs in the same year (excluding the focal firm). Higher levels of IPO launches within the same industry represent greater competition for investor funding in the IPO offerings market among similar firms. The data used to calculate the level of IPO competition were obtained from CRSP. This follows several strategy and finance researchers who have used the number of IPO launches to measure the degree of competition in the stock market (e.g., Ritter, 1984; Stuart et. al., 1999; Gulati and Higgins, 2003).

5.2.1.5 Reversibility

The degree of IPO reversibility (or the inverse of irreversibility) was measured by the number of leveraged-buyout (LBO) and management-buyout (MBO) activities for each industry at the SIC 2-digit level. The level of LBOs and MBOs was used as a proxy for reversibility because for firms that have not yet launched their IPO, the cost of reversing an

IPO cannot be determined as the price of buying back shares and effort in reversing the public status will only be determined once an IPO has been launched. In such a situation, firms are likely to use benchmarks in the market to determine their level of reversibility. Kahneman and Tversky (1984) stated that targets or reference points are typically used by firms when evaluating choices. Availability of a reference point will allow decision makers to use a more rationale approach in their decision making process (Tenbrunsel, Wade-Benzoni, Messick, and Bazerman, 2000).

Thus the use of LBOs and MBOs is based on the assumption that the ability of firms to effectively "reverse their IPO" and go private depends on the availability of LBOs and MBOs in the industry, and that certain industries are more likely to have LBO activities than others (Ambose and Winters, 2001). First, for an LBO to occur, most firms within the same industry must generate enough cash flow to service the debt generally required in an LBO (Jensen, 1989; Ambose and Winters, 2001). The level of cash flow for this purpose will differ by industry. Second, some industries are regulated and may have a lower ability to go private (Ambose and Winters, 2001). Given the industry effect of LBOs, the availability of LBOs within an industry provides an indication of the reversibility of IPOs. This is because the availability of LBOs demonstrates the availability of support for the reinstalling the intangible components of IPO reversals, such as debt funding and revival of constructive relationships among owners, managers, and other corporate stakeholders. The data for LBO availability were obtained from SDC Mergers & Acquisitions.

5.2.1.6 Venture Capital Involvement in Decision Making

The level of involvement of the venture capitalist in the decision making was measured by the amount of capital that the firm had received from their venture capitalists. This follows prior research in which the amount of investment shows both the sunk cost that the venture capitalist has invested in a firm and the extent of accountability among the investors (Staw, 1976; Kahneman and Tversky, 1979). In addition, prior research has shown that in partnerships, the size of partners' investments may affect the level of the partner's involvement in the firm (Parkhe, 1993). In particular, venture capitalists receive voting rights in accordance with the amount invested as if they hold common shares in a firm (Gompers, 1996). Research has also suggests that the greater the venture capital funding, the more frequently the venture capitalists monitor firms and become involved with key decisions (Gompers, 1996). Therefore, the level of capital investment provides an indication of the amount of influence by venture capitalists.

5.2.3 Control Variables

I controlled for several firm-specific and industry factors identified as relevant to the IPO timing in the strategy and finance literature. Firm-specific factors included the age of the firm, the age of the venture capital firm, and the cumulative level of capital invested in the firm by the venture capitalist. Industry factors include the industry market-to-book ratio and the level of borrowing by each industry.

The rationale for controlling for the age of the firm is that older firms may be easier for outsiders to evaluate, resulting in less duplication of information needed for an IPO launch (Myers and Mjluf, 1984; Chenmanur and Fulghieri, 1999). In addition, the age of the firm also provides an indication of the stage of the firm's growth (Maug, 2001; Schultz,

2000). The age value of the firm was calculated by taking the natural log of the difference between the date of a firm's IPO and its founding date. The age was calculated on a monthly basis.

I controlled for the age of the venture capital firms because younger venture capital firms have been found to take companies public earlier than older venture capital firms (Gompers, 1996). This is because younger venture capital firms need to establish a reputation and successfully raise capital for new funds. By taking firms public early, young venture capital firms gain reputation benefits that may support their raise of capital. I measured the age of the venture capital firms in months from the date of their establishment to the time of the IPO launch. In periods where firms have no association with venture capital firms, the age of the venture capital firm was recorded as zero. The data on the age of the firm and their venture capital firms were obtained from SDC VentureXpert.

The rationale for controlling for the cumulative level of venture capital investment that each firm had received is that uncertainty about the quality of young entrepreneurial firms is likely to exist among potential investors (Stuart, Hoang, and Hybels, 1999; Gulati and Higgins, 2003). As a result the estimated value of a firm’s IPO launch and the ability of the firm to launch an IPO may be affected by the level of confidence that venture capitalists are willing to invest in the firm. The level of investments held by a firm also provides an indication of the level of influence that a firm may receive from its venture capitalists in IPO decision making. Firms that have high levels of capital investments from venture capitalists will likely have higher levels of involvement from venture capitalists and need to provide voting rights on key decisions (MacMillan et al., 1989; Zider, 1998). The cumulative level of venture capital investments was measured on a monthly basis.

The industry market-to-book ratio was controlled for because it allowed me to control for differences among industries with respect to industry growth potential (e.g., Folta and O'Brien, 2004; Lehn, Netter, and Poulsen, 1990) and investor sentiment toward certain industries (Maksimovic and Pichler, 2001) across different time periods. According to financial theory, there are windows of opportunities or periods in which the stock performance of firms within certain industries may create an environment conducive to IPOs (e.g., Lowry, 2003; Pagan, Panetta, and Zingales, 1998; Rajan and Servaes, 1997). For example, Pagano, Panetta, and Zingales (1998) found that a one-standard-deviation increase in the industry market-to-book ratio raised the odds of an IPO by 25%.

Lastly, the market value of bank debt for each industry was also controlled for, as the level of borrowing has been documented to influence the likelihood of IPO. Harris and Raviv (1990) found that firms with a high level of borrowing have already been scrutinized by lenders, leading to lower costs of producing information for investors, and thus they have a higher likelihood of launching an IPO. However, conversely, investors may also perceive high levels of borrowing as a potential risk factor and exercise an extra degree of caution when making investments. Thus, unless they are severely underpriced, firms with high levels of bank debt will be less likely to launch an IPO and will instead pursue other alternatives, such as takeovers (Brau, Francis, and Kohers, 2003). In this dissertation I follow Brau, Francis, and Kohers (2003) and use the industry-wide level of bank debt as a proxy for the level of borrowings of private firms, because actual information on private firms' borrowings is difficult to obtain. The use of the proxy is justified by evidence of a strong intra-industry correlation of bank debt levels between private and public funding

(Bradley, Jarrell, and Kim, 1984). The degree of bank debt was measured as the book value of firm debt (long-term and short-term debt).

5.3 Methodology

5.3.1 Hazard Model

I used a hazard model to measure the likelihood of IPO launch. This model estimates the instantaneous risk that the firm will go public in any given time interval. My model follows the early works of Kogut (1991) and Stuart, Hoang, and Hybels (1999) in modeling the likelihood of events. To measure the likelihood of IPO launch, I first constructed a baseline model of the likelihood of launching an IPO, *L(t)*:

$$L(t)_i = \lim [q_i (t, t + \Delta t)/\Delta t] ,$$

where q is the probability that a firm will go public between any two discrete points in time t. This baseline model describes the probability that a firm will go public, assuming no exogenous influences. Next, I used a piecewise exponential model to estimate the effects of the independent variables and control variables on the likelihood of IPO launch. This model provides flexibility and does not require heavy dependence on the time span or the age of the firm. The model assumes that the baseline transition rate is constant within each age period but can vary across periods. The model for the estimated likelihood of IPO launch is as follows:

$$L(t)^*_i = L(t) \exp(\alpha Uncer_t + \beta Rev_t + \gamma Comp_t + \delta Shock_t + \lambda X + \zeta Con_{it}) ,$$

where $L(t)$ represents the baseline hazard rate; *Uncer* is the matrix of the value of the uncertainty factors obtained from the GARCH model (product demand uncertainty and stock return uncertainty), as well as the value of the residual errors; *Rev* is the measure of reversibility; *Comp* is the degree of competition (product market competition and

competition in the IPO offerings market); *Shock* is the matrix of the shock variables (product demand and stock market shock); *X* is the matrix of the interaction of the key variables; and *Con* is the matrix of control variables. The variables α, β, γ, δ, λ, and ζ are the parameters to be estimated. Because the variables in the model change over time, the time series of the model was conducted on a monthly basis.

Theoretically, this model is equivalent to a Cox semi-parametric model showing a hump-shaped pattern: the likelihood of IPO launch first increases as the firm perceives less uncertainty, and then it decreases. The decrease is due to the fact that if the firm has not launched its IPO within a certain number of years, it becomes less likely ever to do so. However, because the sampling period was 17 years (or 204 months), some firms that had not gone public by the end of the period might still have intended to do so but were not observed long enough. Also, the time window for observations differs for each firm depending on when it was founded. For example, in the sample, all firms were tracked until the end of 1996, so a firm founded in 1980 was tracked for 14 years, whereas one that was founded in 1990 was tracked for only 6 years. In order to take these issues into account, left truncation was employed for firms that had entered the sample late, and right censoring for firms that launched an IPO or had dropped out prior to the ending of the sample period.

The next chapter discusses the data analysis performed and the results of the analysis.

CHAPTER 6: RESULTS

The results presented in this chapter show that uncertainty affects firms' IPO launch decisions differently, and that firms factor strategic implications into their IPO launch decisions. In particular, the likelihood of IPO launch depends on the level of uncertainty that firms face, the source of the uncertainty, and the degree of influence that venture capitalists exert in firms' decision making.

In addition, the decision depends on the type of competition that the firm faces. This chapter is organized as follows: section 6.1 provides descriptive statistics of the sample, section 6.2 presents the results of a hazard model on the likelihood of IPO, and section 6.3 summarizes and discusses the results.

6.1 Descriptive Statistics

The descriptive statistics provide an understanding of the level of uncertainty, competition, and irreversibility that a firm faces. They also provide an understanding of the firm-specific factors such as the sectors of firms that are sampled and analyzed in this dissertation. Tables 10 and 11 present the univariate statistics on the types of firms, the age of firms and their venture capitalists, and the amount of venture capital investments by industry at the 3-digit SIC code level. Tables 12–15 present the univariate statistics for factors such as the level of uncertainty, the level of competition, the level of reversibility, the industry market-to-book ratio, and the level of borrowings. In addition, correlations and VIF tests were used to understand the relationships between the variables and check for potential multicollinearity between the variables. These statistics appear in Tables 16–18.

Table 10 shows the number of firms, by type in each sector. These statistics provide interesting insights. First, the major column labeled "No. of Firms" shows that the sample includes firms across 30 sectors, and that there are sufficient firms in most sectors to pick up any potential industry effects. This column also reveals that the distribution of firms across the sectors is not uniform; the medical instruments sector (SIC 384) has the largest number of firms in the sample (505 firms), and the petroleum and coal products sector (SIC 299) and the textile wood working sector (SIC 355) have the lowest number of firms in the sample (one per sector). The breadth of industries (or multiple SIC codes) in the sample, the large number of firms in most of the industries, and the fact that subjects are tracked over several years is important for the research methodology. This is because investor sentiment toward IPOs in certain sectors has been shown to fluctuate in some years (Maksimovic and Pichler, 2001). Thus, the statistics confirm that any industry effects across years will be captured in the model.

Second, 31.4% of the firms in this sample launched their IPO during 1980–1996. However, this rate varied greatly across sectors; firms in the medicinal chemicals sector (SIC 283) had the highest rate of IPO, at 53% of all firms, and firms in the mechanical tools sector (SIC 354) were among the lowest, at about 8%.

Third, the second major column (labeled "No. of Firms with VC Funding") and the third (labeled "No. of Firms Without VC Funding") show the breakdown of the sample according to firm type. The sample shows that although the total number of firms that did and did not receive venture capital funding in each category is roughly equal, the proportion of firms that had launched IPOs differs by industry. For example, among firms that had launched their IPOs in the medicinal chemicals sector (SIC 283) the proportion of

those that had received venture capital funding was twice that of firms that had not. Conversely, in the construction machinery (SIC 353) and machinery tools (SIC 354) sectors, some firms that had no venture capital launched IPOs, but no firms that had received venture capital launched an IPO. This supports the notion that in some industries, the type and level of capital investments by venture capitalists may influence the likelihood of IPOs. These factors are controlled for in the model.

Table 11 shows the average age of the firms, the average age of the venture capitalists, and the amount of cumulative venture capital funding held by firms. These statistics provide insights into the amount of firm-level uncertainty or the level of maturity of the firm, as well as the potential influence of venture capitalists at the time of the IPO launch. First, the age of the firm has been used to determine the amount of uncertainty that investors may have toward a firm. Older firms are likely be more established, have longer track records, and have more information available regarding them (Rock, 1986). These attributes decrease the uncertainty to prospective investors. The major column labeled "Ave. Firm Age at IPO" shows that the average age of firms in the sample at the time of IPO was 5.3 years. However, the average age of firms at IPO also differed greatly across sectors: firms in the plastic and synthetic resins sector (SIC 282) had the lowest average age at IPO (2.75 years) and firms in the machine and hand driven tools sector (SIC 354) had the highest average age at IPO (7.5 years). These differences were evident across sectors and among firms within similar product ranges and SIC codes. For example, firms in the industrial, machinery, and equipment industry sectors (SIC 35) varied between the construction machinery sector (SIC 353) in which the average age at IPO was close to four

years, and those in the machine and hand driven tools sector (SIC 354) in which the average age at IPO was about 8 years.

Second, the major column labeled "Ave. VC Age at IPO" shows a large variance in the age of venture capitalists at the IPO timing. This large distribution is important because previous researchers have found that younger venture capitalists have greater propensity to push firms to go public early (Gompers, 1996). These effects are captured in the model as control variables.

Third, the third major column (labeled "Ave. Investments Held") and the forth (labeled "Ave. Investments Held at IPO") show that the average amount of venture capital held by firms varied across firms and across the duration of the sample period. On average, firms held capital investments of $2.7 million across time (the average includes periods in which no capital investments were held by firms during the initial start-up period). The maximum amount of capital investments held at any given point of time was $389 million. There is a large variance in the amount of capital that firms held at the time of IPO, with values ranging from zero to $260 million of venture capital investments. The amount of capital held by each firm varied across time, and the level of investments at the time of IPO launch is not necessarily the highest. Again, this variance allows for capturing the level of venture capitalist influence, especially during the launch period.

Table 12 shows the univariate statistics on the level of product demand uncertainty and stock return uncertainty of the 30 sectors across the 17–year period of this study. The level of uncertainty for both product demand and stock returns was measured by the conditional variances derived from the GARCH model. The values ranged from zero to one. Uncertainty values close to zero represent very low or no uncertainty and uncertainty

values close to one represent very high levels of uncertainty. These statistics reveal interesting differences across industries and time frames, and provide an indication that the differences between product demand uncertainty and stock return uncertainty merit separate examination. First, most industries show large variances in the level of uncertainty across time, with periods of very low levels of uncertainty (0.000) and periods of high uncertainty (>0.900) in both product demand and stock returns. Second, there is considerable variation between the levels of uncertainty in product demands and stock returns among sectors. For example, for the gum and wood chemicals sector (SIC 286), the level of product demand uncertainty was consistently low (0.000) across time. However, for the same sector, the level of stock return uncertainty remained relatively high (0.526 to 0.915) throughout the 17–year period. Another example is the metal rolling sector (SIC335), in which the level of product demand uncertainty had large swings (0.000 to 0.863) but the stock return uncertainty remained low (0.000) throughout the 17–year period. Only the pumps and compressor sector (SIC 356) and lab apparatus sector (SIC 382) showed little difference in uncertainty in the product market and the stock market (comparison across the means yielded $F=0.03$ and $F=3.774$ at $p> 0.05$ respectively).

Table 13 shows the univariate statistics on the level of competition in the product market (measured at the SIC 3-digit level) and the stock market (measured at the 2-digit level) across the 17-year period. These statistics reveal interesting differences across the two sources of competition. First, except for two sectors (SIC 334 and 393), there is little variation in the level of product market competition within each sector. On the contrary, there is considerable variation of competition for funding in the stock market across

industries: some industries had periods with no or few IPO launches (i.e., SIC 33), whereas some industries had many IPO launches throughout the 17 years (i.e., SIC 35).

Table 14 shows the univariate statistics on the market-to-book ratio and the book value of debt of the sectors across the 17–year period. The market-to-book ratio confirms that some industries have a higher proportion of growth opportunities than others (Myers, 1997), and that the level of growth opportunities changes across time. The statistics also suggest a large variance in the levels of borrowings across industries and across time. For example, in the plastics and synthetic resin sector (SIC 282) the level of total debt within the sector averaged $816 million, whereas in the musical instruments sector (SIC 393) the value was only $30 million. Also in the photographic equipment sector (SIC 393), the value of debt ranged from $50 million to $203 million across the 17–year period. These differences in borrowing suggest that firms in different sectors and during different periods may have different requirements for funding. The differences, which may influence the likelihood of IPO, are captured through the control variables. Table 15 summarizes the univariate statistics.

Table 16 presents the Pearson correlation coefficients of the independent variables used in the hazard model that follows. The correlations show interesting patterns. First, there were no "large" values of bivariate correlations between independent variables: no correlations were greater than 0.4. Second, the correlation between product demand uncertainty and stock market uncertainty is low (0.02). This supports the assumption described in the earlier chapters that the product demand and stock return may not be highly correlated. Third, product market competition has some weak correlations with product demand uncertainty (-0.25), the level of competition for funding in the stock

market (0.25), and the industry market-to-book value (0.27). This is not surprising because firms may be more aggressive toward potential rivals when demand is stable. Similarly, industries with higher levels of market concentration will likely have more financial activities, resulting in higher amounts of competition in the stock market. In addition, industries with high valuations or high market-to-book ratios are likely to attract more firms; thus, competition among such firms is likely to be higher.

Fourth, some weak correlations exist between the industry market-to-book ratio (control variable) and the level of competition for funding in the stock market (0.27) and the level of uncertainty in the stock market (-0.34). This, too, is not surprising because the level of market-to-book ratio also represents the potential amount of funding that a firm can gain through the stock market. Thus, higher market-to-book ratios will likely be followed by greater competition for funding through IPOs. Also, increases in stock prices above the book value will likely result in less stability in the market-to-book ratios. These correlations are unlikely to cause large econometric problems in the hazard model because the correlation levels are not high. This will be tested through variation inflation tests and condition indexes, and discussed in the next paragraphs.

Table 17 shows the results of the tolerances or the variance inflation (VIF) tests among the control variables and the independent variables. All VIF indexes were less than 2. Thus, there appears to be little need for concern about collinearity among the variables. This in accordance with the "rule of thumb" that variance inflation indexes of 10 or more may be a reason to be concerned about multicollinearity.

Table 18 shows the results of the collinearity diagnostics tests. The highest condition index is about 9.4. This can be interpreted to indicate some very weak forms of

collinearity among some of the independent variables. According to the rule of thumb on collinearity diagnostics, when the condition index is 15 or higher, there may be some weak forms of collinearity; when the condition index is 30 or above, collinearity starts to become a great concern (Belsey, Kuh, and Welsh, 1980). To determine whether collinearity will affect the hazard model, detailed analysis and sensitivity tests were conducted for models 1–15. First, both t-ratios for individual coefficients and the overall F-ratio were statistically significant. Second, all coefficients were stable when used with different combinations of samples and independent variables for slightly different specifications of the model. Third, as variables were added to the model, there were no signs of effects (e.g., switches from positive to negative or vice versa). The results of the analysis and sensitivity tests indicate that there is little reason to be concerned about collinearity in the model.

6.2 Results

Tables 19–22 show the results of the hazard model. Table 19 presents the base models of the relationship between uncertainty and the likelihood of IPO. Table 20 presents the impact of reversibility and venture capitalists' influence on the likelihood of IPOs. Table 21 presents the impact of competition on the likelihood of IPO. Table 22 summarizes the likelihood of the IPO model based on a continuous time flow and presents the likelihood of the IPO model based on a punctuated time flow. For each of the individual coefficients, the parameter estimates, the significance of the parameter estimates, and the hazard ratio is reported. The significance of individual coefficients is interpreted using two-tailed Wald chi-squared tests. For each model, a likelihood ratio test was conducted by comparing the key main variables and/or interaction variables against a specified base model. In addition, a figure of a baseline model of the likelihood of IPO (Figure 4) was

constructed in order to compare the cumulative function of IPO likelihood against the key effects (or time varying covariates). This baseline model represents the function of time variance alone without the covariates (i.e., the likelihood of IPO across time without the influence of the external environment).

6.2.1 The Base Model: Control Variables

Model 1 of Table 19 reports the estimation of the effects of the control variables on the likelihood of IPO. The age of the firm, the age of the venture capitalist, the amount of venture capital investments held, and the industry market-to-book ratio were all positively associated with the likelihood of IPO, whereas the level of bank borrowing was negatively associated with the likelihood of IPO. Among these variables, the age of the venture capitalist and the level of the market-to-book ratio had the most significance; an increase in venture capitalist age by one year increased the likelihood of IPO by approximately 34% and an increase in the market-to-book ratio by unit increased it by 37%. Together these control variables account for approximately 40% of the variance in the base model. This level of variance is in accordance with previous studies in finance on firms' IPO timing (Lowry, 2003; Pagano, Panetta, and Zingales, 1998; Gompers, 1996)[4].

[4] No studies carry the same variables as the control models used in this research that can be used as a direct comparison. Also, existing studies only include samples of firms that have already launched IPOs. However, the similarities in some of the variables used and the similar range of R^2 value indicate that the control model accords with previous studies. A model on age at IPO (which included the following variables: size of the IPO offering, the underwriter rank, and the amount of VC investments held) had an R^2 of 23.2% (Gompers, 1996). A model on the number of IPOs launches (which included the following variables: market-to-book ratio and equally weighted market returns) had an R^2 of 23.7% (Lowry, 2003). And a model of the probability that a firm will go public (which included the following variables; sales, capital expenditure, return on assets (ROA), the level of firm borrowings, and the market to book ratio, had an R^2 of 14.3% (Pagano, Panetta, and Zingales, 1998).

6.2.2 The Effects of Uncertainty: Hypotheses 1A-2B

The key independent variables—product demand uncertainty and stock return uncertainty—were added in Model 2 and Model 3 separately in order to determine their effects separately, and then added jointly in Model 4. Model 2 shows that product demand uncertainty is negatively and significantly related to the likelihood of IPO: an increase in product demand uncertainty by one unit decreases the likelihood of IPO by approximately 35% (Hazard ratio 0.646 -1). This supports the theory of real options reasoning that under uncertain product market conditions, firms will defer their IPO. This relationship is depicted in Figure 5. Thus, Hypothesis 1A is contradicted, but its counter hypothesis, Hypothesis 2A, is supported. Model 3 shows that stock return uncertainty is positively and significantly related to the likelihood of IPO: an increase in stock return uncertainty by one unit increases the likelihood of IPO by approximately 80%. This supports the theory of entrepreneurial action that under uncertain stock market conditions, firms will take action. This relationship is depicted in Figure 6. Thus, Hypothesis 1B is supported but its counter hypothesis, Hypothesis 2B, is contradicted. Model 4 shows the effects of product demand uncertainty and stock return uncertainty combined, in which the relationship found in Model 2 and Model 3 is maintained, although the significance of the product demand uncertainty on the likelihood of IPO is weakened.[5] The likelihood ratio tests (goodness-of-fit between two models) indicates that the addition of product demand uncertainty and stock return uncertainty (Model 4) improves the model fit relative to the control model

[5] The level of significance for product demand uncertainty reduced from 0.05 level to 0.10 level. Although this level of significance falls below the traditional levels of acceptance (0.05), the direction of the results is in keeping with the hypothesis. A significance level of 0.10 has been regarded as acceptable when the direction, not the size of the effect, is central to the purpose of the research (e.g., Fischer and Pollock, 2004; Cohen, 1995 and 1994).

(Model 1) at a significant level of 0.001, and the proportion of explained variance in the model (R^2) increases from approximately 40% to 45%.[6]

6.2.3 The Effects of Irreversibility: Hypothesis 3

The independent effect of reversibility (or irreversibility) on the likelihood of IPO is reported in Model 5 of Table 20. Model 5 shows that the effect of reversibility was not significant. Given the nonsignificance of reversibility, further interaction tests to support Hypothesis 3 were not reported. This will be discussed further in Section 6.3.3.

6.2.4 The Involvement of the Venture Capitalists: Hypothesis 4

Models 6–8 show the results of the interactions between uncertainty and the level of venture capital investments held. Model 6 shows that the interaction effect between product demand uncertainty and level of investments on the likelihood of IPO was positive and significant, but small. This implies that the higher the level of investments from venture capitalists (or the higher the influence of the venture capitalists), uncertainty in product demand will have a slightly stronger effect on the likelihood of IPO. This relationship, which is depicted in Figure 7, contradicts Hypothesis 4 and will be discussed in the next chapter.[7] Model 7 shows that the interaction effect between stock return uncertainty and the level of investments on the likelihood of IPO is negative and significant, but small. This implies that if the level of investments from venture capitalists is high, uncertainty in stock

[6] Some researchers have found curvilinear effects of uncertainty (e.g., Folta and Miller, 2004). Tests were conducted for product demand uncertainty and stock return uncertainty, both at the second power; however, no curvilinear effects with these two variables and the likelihood of IPO were found.

[7] According to Hypothesis 4, as venture capitalists become more involved, the relationship between product demand uncertainty and the likelihood of IPO will be explained by a real options reasoning approach. However, as shown in Figure 7, which depicts the results of the tests for Hypothesis 4, as the level of investment held increases, the relationship between product demand uncertainty and the likelihood of IPO decreases at a decreasing rate. Figure 8 shows that as the level of investment increases, the relationship between stock return uncertainty and the likelihood of IPO increases at a decreasing rate.

returns will slightly strengthen the positive relationship between stock return uncertainty and the likelihood of IPO. This relationship, which is depicted in Figure 8, partly supports Hypothesis 4 and will be discussed in the next chapter. Model 8 integrates the main and interaction variables of the two models, in which the significance of the product demand uncertainty x level of investments interaction term is maintained; however the significance of the stock return uncertainty x investments interaction term is weakened. The likelihood ratio test indicates that the addition of interaction variables (Model 8) improved the model fit relative to the model without the interactive terms (Model 4) at a significant level of 0.001.

6.2.5 The Main Effects of Competition: Hypothesis 5A-5B

The individual effects of product market competition and competition in the IPO offerings market on the likelihood of IPO are shown in models 9 and 10. Model 9, which is depicted in Figure 9, shows that product market competition is positively related to the likelihood of IPO at the 0.10 significance level. This supports Hypothesis 5A that the level of competition in the product market will increase the likelihood of IPO. Model 10 (Figure 10) shows that competition in the IPO offerings market is positively related to the likelihood of IPO with significance ($p<0.05$). This supports Hypothesis 5B that the level of competition in the stock market will increase the likelihood of IPO.

6.2.6 The Interaction Effects of Competition: Hypothesis 6A-6B

Models 11–13 show the results of the interactions between uncertainty and competition. Model 11, which is depicted in Figure 11, shows that the interaction term between product demand uncertainty and competition in the product market is negative and significant. This implies that at higher levels of competition in the product market,

uncertainty in the product market will reduce the likelihood of IPO. This supports Hypothesis 6B. Model 12 (Figure 12) shows that the interaction term between stock return uncertainty and competition in the IPO offerings market is positive and significant. This implies that at higher levels of competition in the stock market, the effect of uncertainty in stock returns will reinforce the likelihood of IPO. This supports Hypothesis 6B. Model 13 integrates the interaction variables of the two models, in which the significance of the two interaction effects still holds. These results reinforce the notion that competition in different types of markets may have different effects and influence firms' actions differently. In particular, in the product market where blind spots exist, firms that are able to recognize opportunity will gain competitive advantages. However, when the blind spots are eroded, any competitive advantage gained may quickly erode.

6.2.7 Summary of IPO Likelihood Model – Continuous Time Flow (Hypotheses 1A-6B)

Model 14 in Table 22 shows the result of all the main variables and interactions variables from Hypothesis 1A to 6B. Most notable is that when compared with the control model (Model 1), the results show that the addition of the independent variables and interaction variables increased the explained variance by 8.7% (the adjusted R^2 rose from 40.8% to 49.5%). The likelihood ratio test indicates that the addition of the key variables and interaction variables improved the model fit relative to the base model (Model 1) at a significant level of 0.001.

6.2.8 IPO Likelihood Model - Punctuated Time Flow (Hypotheses 7A-7B)

Model 15 reports the estimation of the effects of the positive shock variables on the likelihood of IPO. The positive demand shock is positively and significantly related to the likelihood of IPO; a product demand shock increases the likelihood of IPO by

approximately 2%. However, the relationship between the stock market shock and the likelihood of IPO was not significant. These results reinforce the notion that the product market may be opaque and thus firms take cues from large shocks in the environment as cues, whereas in the stock market, where information is clear, firms monitor the market frequently and make decisions on a continuous basis.

6.3 Discussion of Results

Overall, the findings in this dissertation support most of the hypotheses. Table 23 summarizes the hypotheses and results for the IPO likelihood model. This section analyzes the results in greater depth and interprets the meaning of the results.

6.3.1 Uncertainty

The findings in this dissertation are among the first to demonstrate empirically that the relationship between uncertainty and likelihood of IPO depends on the source of uncertainty. The results show that environmental conditions in both the product market and stock market influenced the likelihood that a firm will launch an IPO; however, the directions of the influence of the two markets were opposite. Uncertainty in the product market induced firms to act in accordance with the theory of real options reasoning and defer their IPO until product market conditions become clear, whereas uncertainty in the stock market induced firms to act in accordance with the theory of entrepreneurial action and launch their IPO when uncertainty was high. Such differences in IPO launch decisions may be due to the characteristics of each market, and the heuristics and biases that the entrepreneurs may have toward each market. The product market is characterized by opaqueness (Miller and Friesen, 1984); there are no clear general market indicators or easily obtainable information that help firms recognize and understand opportunities that

can be supported by an IPO. Thus, under highly uncertain conditions, firms will incur higher costs in decision making (Simon, 1979). This results in firms deferring their IPOs under uncertain conditions in the product market. In contrast, the stock market provides clearer signals, with several market indicators and information that is readily available through the media. Therefore opportunities in the markets that can be supported by an IPO are recognizable and easily understood. This results in firms launching IPOs at high levels of uncertainty in the stock market.

6.3.2 The Level of Venture Capitalists Involvement

I also attempted to demonstrate that firms respond to uncertainty differently depending on the level of influence that venture capitalists have in the decision making. However, the results were mixed; the assumption was not supported in the product market, but was supported in the stock market (but the effects were small). First, in general, the results showed that having venture capitalist backing slightly increased firms' likelihood of IPO. This is likely due to venture capitalists' ability to manage uncertainty through leveraging their previous experience with other high growth firms. This supports the notion that managers with more experience in the market will have better skills in detecting information that may be pertinent to reducing the overall perceptual uncertainties (Milliken, 1987; Jackson and Dutton, 1988; Barringer and Bluedorn, 1999). Second, the results showed that when venture capitalists have low levels of influence in firms, as uncertainty in the product market increases, firms will reduce their likelihood of IPO at an increasing rate. This contradicted the hypothesis that predicted that, as uncertainty increases, firms with low levels of influence from venture capitalists would act in accordance with an entrepreneurial action approach and increase their likelihood of IPO.

That firms with low levels of influence from venture capitalists in their decision making continued to act in accordance with a real options reasoning approach and decreased their likelihood of IPO is likely due to both the opaqueness of the product market and the lack of support from venture capitalists in overcoming the perceptual uncertainties in that market. Third, the results showed that when firms have low levels of influence from venture capitalists, as uncertainty in the stock market increased, firms slightly reduced their likelihood of IPO at a constant rate. However, the magnitude of this effect was very small. This is likely because the stock market is easy to interpret; therefore both entrepreneurs and venture capitalists were aligned in their interpretation of the growth opportunities available through an IPO.

6.3.3 Irreversibility

The issue of irreversibility of IPOs has generally been ignored in both finance and strategy research. In this dissertation, I attempted to measure the direct and moderating effects of irreversibility on firms' likelihood of launching an IPO. However, the results were not significant. One explanation may be my reliance on the number of LBOs/MBOs as the measure of irreversibility. This is because although the number of LBOs/MBOs indicates the infrastructure available to support a firm's "going private," the number of LBOs/MBOs may also indicate that the general environment may be more conducive to a firm remaining privately held. In particular, industries with many LBO/MBO occurrences typically go through major restructurings in order to regain the efficiency that firms had when they were privately held (Draho, 2004). Decision makers may deem periods with a large number of LBOs/MBOs in the market as a signal that it will be beneficial to remain private. Given the different potential framings that managers may have despite facing the

same phenomena (Kahneman and Tversky, 1979; Fiegenbaum, Hart, and Schendel, 1996), it is not surprising that managers may opt for different strategic directions with regards to their IPO launch.

6.3.4 Competition

The findings in this dissertation demonstrate that competition matters in IPO launch decisions. The results show that both competition in the product market and the IPO offerings market directly increased firms' likelihood of IPO, with significance. This provides evidence that the IPO stage is not merely a transition that brings financial growth or a "cash-out" vehicle, but also a competitively induced action, and thus deserves further research attention in the field of entrepreneurship and strategy.

The findings also demonstrate that the presence of competition influences how firms respond to the general environment. In the product market, the results show that under low levels of product competition, as uncertainty in the product market increased, firms increased their likelihood of IPO. However, when the level of product competition was high, as uncertainty in the product market increased, firms decreased their likelihood of IPO. The different effects of product market competition on how firms' timed their IPO launch under different levels of product demand uncertainty is likely due to the nature of the product market, which is characterized with opaqueness in information and presence of competitive blind spots. Low levels of product competition allow firms to build their post-IPO competitive advantages without triggering a response from rivals. However, when competition is high, the leakage from an IPO process will allow rivals to erode any post-IPO competitive advantages gained. Thus, the timing of an IPO launch needs to be managed properly in order to yield strategic advantages for a firm.

6.3.5 Positive Shocks

Although I hypothesized that firms may use benchmarks or long-term growth trends as references, and launch their IPOs when there is a high deviation from these benchmarks or trends, only product demand shocks increased the likelihood of IPO. Positive shock in the stock market did not affect the likelihood of IPO. One reason may be the nature of the differences between the product market and the stock markets. As product market conditions may not be clear and are difficult to interpret, the need to launch an IPO may become evident only when positive shocks occur. This supports the notions of the information-processing limits of decision makers (Abelson and Levi, 1985) and punctuated time flows (Schumpeter, 1934). In contrast, the stock market is characterized by indicators that are easy to understand and readily available from the media. Therefore, firms are likely to monitor market conditions frequently in determining their IPO launch timing and rely less on stock market shocks as triggers to take action. This supports the notion that firms follow a continuous time flow approach in making their IPO launch decisions.

6.4 Summary

While most of the key proposed relationships were supported, some relationships were not fully supported. These results offer a credible explanation for the timing of IPOs. The next chapter will provide further implications of this research for researchers, managers, and policy makers; the limitations of the findings; and proposed future research directions.

CHAPTER 7: IMPLICATIONS AND FUTURE STUDIES

The final chapter discusses the implications of this study, its limitations, and directions for future research. First, the theoretical implications and contributions are presented; second, the managerial implications; and third, the policy implications. The last section concludes the dissertation by discussing the study's limitations and potential future research directions.

7.1 Research Implications

The dissertation provides insights into the considerations pertaining to IPO launches that advance concepts and theories in strategy and entrepreneurship research. Specifically, the dissertation (1) provides insights into decision making about IPOs, (2) reconciles contradictory theories within strategy and entrepreneurship, and (3) highlights the role of timing in strategy research.

First, this dissertation demonstrates that strategy and entrepreneurship theories can be used to explain IPO timing decisions with timing measured as the likelihood of IPO. Previous researchers have mainly used financial theories and assumptions to explain why and when firms launch IPOs. This has resulted in gaps and inconsistencies between research expectations and the actual IPO phenomena. In particular, the integration of the theories and perspectives of the competitive dynamics, real options reasoning, and entrepreneurial actions contribute to a better understanding of IPO launch timings from a strategic perspective—rather than from that of an investor, which has been predominantly researched in the past.

Second, this dissertation reconciles contradictory perspectives from the theories of entrepreneurial action and real options reasoning with regards to firms' response under uncertain conditions. Specifically, this study found that in the product market, the relationship between uncertainty and the likelihood of IPO is better explained by the theory based on real options reasoning, whereas in the stock market, the relationship between uncertainty and the likelihood of IPO is better explained by the theory based on entrepreneurial action. The research also found that firms respond to competition differently; increased competition in the product market decreases firms' likelihood of IPO launch, whereas increased competition in the IPO offerings market accelerates that likelihood.

Third, this dissertation highlights timing as a decision-making criterion, measured as the likelihood of launching an IPO, and the managerial heuristics used in determining IPO launch timings. Despite efforts to encourage studies on timing (e.g., Bluedorn and Denhardt, 1988; Entrepreneurship Theory and Practice, Special Issue 1998; Academy of Management Review, Special Issue 2001), relatively little research has been done on timing as a decision criterion. Much of the research that incorporates timing into action is grounded in the logic that time is "linear and scarce, and faster is better" (Bird and West, 1998). This research demonstrates that firms consider timing to be important in their decision making and recognize the strategic value of deferral; when faced with uncertainty in the product market, firms delay their action or take action when conditions become clearer. This research also integrates theories on managerial heuristics and demonstrates that when clear indicators on the value of their actions are lacking, firms use environmental cues and signals to determine the timing of their actions. Specifically, the research found

that in the product market where no clear indicators exist, firms take a punctuated equilibrium approach, whereas in the stock market where clear indicators exist, firms make decisions based on a continuous time flow.

7.2 Managerial Implications

This dissertation offers several contributions to managerial practice that entrepreneurs and venture capitalists may wish to consider. The insights pertain to (1) the management of firm growth through IPOs with respect to uncertain environments, (2) the factors that may indicate the potential strategic advantages and disadvantages of early IPO timings, and (3) the importance of information and knowledge on the state of the general environment. These contributions are discussed below.

First, the research provides insights into how firms vary their IPO timing in order to grow. Recent articles and books have discussed the importance of considering an IPO as a growth vehicle as opposed to being used for purely financial purposes (e.g., Champion, 2001; Garnsey, 2002:119). However, there has been less focus on what kinds of indicators managers use to assess growth opportunities available through an IPO and, more importantly, how managers react to these indicators. This research shows that managers act in accordance with the theory of real options approach with respect to uncertainty in the product market. Although such action allows firms to avoid risky outcomes, it also entails foregoing growth opportunities inherent in the market. This research also shows that managers act in accordance with the theory of entrepreneurial action with respect to uncertainty in the stock market. However, by doing so, firms compete against rivals for opportunities inherent in the market that are easy to recognize and understand. Thus, more

emphasis on recognizing and understanding the opportunities inherent in the product market can provide firms with unique opportunities for growth against competition.

Second, this research provides managers with a better understanding of the strategic advantages and disadvantages that firms may consider in timing an IPO launch. While managers may face pressure for early IPO launches—both from investors who seek early returns and due to threats from rivals who seek capital from the stock market—under some circumstances there are several strategic advantages to deferring IPOs. For example, when product market conditions are uncertain, firms that defer their IPO gain the opportunity to learn more about the appropriate course of action and can then be more efficient in production, staffing, sales, and marketing when they launch an IPO. These actions are likely to have positive long-term consequences for firm growth. By rushing an IPO launch, despite satisfying investors, a firm may deploy resources inefficiently, which may hamper its growth. Another example is that when uncertainty is high and competition is stiff in the product market, a firm launching an IPO provides other firms with information about its strategy and tactics. The availability of such information may quickly diminish any advantages the firm may have sought through an IPO. Thus, by deferring an IPO launch, firms may be able to better gauge rivals' strategies and tactics and counteract them. However, these notions need to be confirmed through further testing.

A third contribution this research makes to management practice involves the recognition of opportunities under uncertain conditions. The findings suggest that individuals react differently to different sources of uncertainty. The difference may be due to their difficulty in understanding the growth opportunities inherent in the product market. If so, this suggests that increased focus on opportunity recognition skills in the product

market may provide managers with advantage over rivals in achieving firm growth. Advantages may be gained in several ways. One way is for firms to engage managerial teams with varied backgrounds to interpret and determine the opportunities in the product market. This is because managers with varied backgrounds pay attention to different segments of the environment that affect the type and depth of information that can be used for determining the opportunities available to a firm (Dutton and Duncan, 1987). Another way is for firms to engage individuals experienced in interpreting product market conditions, such as venture capitalists and consultants, to support their recognition of opportunities. This is because individuals who are very familiar with the external environment will have better scanning and opportunity recognition abilities (Barringer and Bluedorn, 1999).

7.3 Policy Implications

This research also has policy implications. Traditional entrepreneurship policies have been directed to the goal of creating local jobs; as a result, these policies have mainly focused on incentives for business recruitment and retention within local economies. There has been less focus on business education for entrepreneurial growth, in particular, to enhance the abilities of entrepreneurs who have already started firms to recognize opportunities. By supporting opportunity recognition skills among firms that are established and are contemplating further growth through an IPO, local governments can provide firms with effective tools to strengthen their competitive advantage within both the local and the broader economy. This is because firms that can recognize opportunities inherent in the product market will be able to take advantage of them and gain competitive

advantages over their rivals. This in turn will strengthen the overall economic base within the local economy.

Local governments could help firms enhance their opportunity recognition skills in many ways. Local governments could catalyze the supply of relevant market information and support from private service providers to local entrepreneurs. The presence of mentors, access to networks of qualified service providers, and participation in professional forums can help entrepreneurs enhance their opportunity recognition skills (Ozgen and Baron, 2004). Thus, by helping entrepreneurs to have access to relevant information and services, local governments could support firms in determining their IPO launch decision based on entrepreneurial activities.

Another way local governments could assist is by supporting entrepreneurship education to enhance opportunity recognition skills, which can be enhanced through effective training (Baron, 2006; National Commission on Entrepreneurship, 2001). Such training could include activities such as college-level courses or business plan competitions. By using local education systems to nurture future entrepreneurs through entrepreneurship courses and activities, local governments may be able to support firms to effectively time their IPO launch.

7.4 Limitations and Future Research Directions

The study for this dissertation developed and tested hypotheses about how entrepreneurs manage their firm growth through the timing of their IPO launch. However, as with any research, this dissertation has some limitations that are important to acknowledge. These limitations, along with the results of this dissertation, suggest several directions for future research.

First, I did not distinguish whether the venture capitalists involved were generalists or specialists. Further research is needed to determine how firms associated with different types of venture capitalists respond differently to various types of uncertainties and competition. In determining the timing of the IPO, I expect that firms that have specialist venture capitalists are likely to have a better understanding of and greater sensitivity to the uncertainty factors in the stock market and competition within the IPO offerings market. Venture capitalists that specialize in certain industries are more likely to have expertise in the industry of the firm and have greater knowledge from previous investments on firm growth. Thus, they are likely to be better able to detect the optimal IPO timing based on the product market trends. This is consistent with the notion that firms in specific industries are more likely to sense competitors' actions within the same industry (Smith, Grimm, Gannon, and Chen, 1991) and that decision makers with diverse skills and orientations are better equipped to make sense of environmental complexity and change (Bantel and Jackson, 1989; Dutton and Duncan, 1987).

Second, this research did not consider competing hazards that may have arisen during the sample period (i.e., the possibility that firms may select an action other than an IPO launch). As this research focused on firm growth, any buy-outs or mergers that occurred were considered as drop outs and were right-censored. However, uncertainty in the general environment and certain strategic considerations could induce entrepreneurs to sell their firm or merge their firm with a partner rather than launch an IPO. More research is needed to understand how competing hazards such mergers and acquisitions and buy-outs may affect the likelihood of an IPO launch.

Third, although this research sheds some light on the strategic considerations that influence the consequence of IPO choice and timing, it does not address the resultant firm growth performance after the IPO. Traditionally, IPO success has been measured by the amount of capital firms were able to raise through the IPO (e.g., Stuart et al., 1999; Gulati and Higgins, 2003). However, anecdotal evidence suggests that a large number of firms that have acquired capital resources through an IPO launch do not perform well with regards to sales growth post-IPO. Only 70–75% of IPO firms survive the first five years after the IPO (Jain and Kini, 2000; Fischer and Pollock, 2004). Therefore, it is important to extend this research to examine how the timing of the IPO launch with regards to strategic considerations in the market actually transforms into firm growth, in order to respond to queries such as: Do early IPO timings under high levels of competition provide better growth opportunities? Or do later timings provide better growth opportunities?

In this research, I hypothesized that firms would consider their strategic considerations based on the general environment when determining their IPO launch. I did not elaborate on internal factors in the models (e.g., the age of the firm, the age of the venture capitalist, as well as the cumulative amount of investment capital held by the firm). However, to extend this research in order to examine how strategic considerations in IPO launch timing actually translates to post-IPO firm growth, both the general environment and internal environment must be considered. Whether firms are able to leverage their IPO timing choice based on strategic considerations in the general environment and translate it to their advantage will likely hinge on the firms' ability to effectively transform the capital acquired through the IPO into growth-enhancing absorbed slack. This is in accordance with the Penrose (1959) theory of the growth of the firm, in which resources become dynamic

capabilities when they are actively deployed. Firms that launch their IPO early due to strategic considerations in the general environment, but are ineffective in transforming their acquired capital to growth enhancing absorbed slack, may actually support rivals by providing them with better advantages in both the product market and stock market.

For example, in the product market, early IPO-launchers must be able to convert their acquired capital into research and development activities, production facilities, or marketing activities and gain market share with speed and efficiency. Otherwise, any benefits sought from an early IPO launch are likely to be diminished—early IPO launchers will give proprietary information and potential market share to rivals with better capabilities and greater efficiency in using capital resources. Under such conditions, despite the strategic advantages of early moves based on the general environment, the internal environment of a firm may provide reasons for it to defer an IPO launch. Further research is needed to determine how the general environment (both the product market and stock market conditions) interact with a firm's internal environment to determine the optimal IPO launch timing and the resultant post-IPO firm growth.

Fourth, there are some limitations in the research methodology that could be modified. For the dependent variable, I used the likelihood of IPO to measure the timing of a firm's IPO launch. However, other methods could be explored, such as the actual timing from the firm's founding or from when it gained venture capital backing to the IPO launch date. For the sampling time frame, I only sampled firms that were founded during 1980–1996 and censored the analysis at 1996. However, with increased information, the relationship between several time varying covariates and the likelihood of IPO could be tested beyond 1996.

Fifth, I only examined the likelihood of IPOs among entrepreneurial firms. However, there are other firms besides entrepreneurial firms that also launch IPOs. These firms include subsidiaries, spin-offs, or firms that have been long established. Studying such firms could provide a comprehensive understanding of when and why firms go public.

Lastly, this research empirically examines the theories derived from real options reasoning from the organizational decision maker's perspective, but, similar to other research on decision making and option reasoning, does not incorporate the decision making and/or potential use of the real option reasoning of other related constituents: the investors, venture capitalists, and investment bankers. They are likely to perceive uncertainty differently, and thereby recognize options differently. This is because an IPO normally comes only once in a firm's life course, and thus entrepreneurs are likely to lack experience in this important firm transformation. Venture capitalists' and investors' portfolios are likely to have numerous examples of IPO investments. This is consistent with the literature on environmental scanning in which those who have acted entrepreneurially in the past will posses better environmental scanning abilities than those who have not (McMullen and Shepherd, 2005). How the interplay of different constituents with different values of option reasoning contributes to the IPO timing deserves further research attention.

In summary, this dissertation highlights how firms use strategic considerations in managing the timing of their IPO to achieve growth. The results are consistent with the notion that IPOs have strategic implications and that the product market plays an important role in determining the IPO launch timing. While this research has provided insights into

the factors that determine IPO timings, much remains to be explained. Many opportunities exist to replicate and expand this study.

Table 1. Summary of the IPOs in the Entrepreneurship Literature

Aspect	Theoretical / Empirical Model	IPO Aspect
Life cycle	Prasad, Vozikis, Burton, and Meriken (1996) Smith and Smith (2000) Shepherd and Zacharakis (2000)	IPOs are regarded as "harvesting of crops." IPOs occur during the high growth/later stages of the lifecycle. Geographic locations may contribute to different IPO timings.
Ownership and Control	Bhide (2000)	IPOs are likely to be deferred to as long as possible due to (1) unwillingness of owners to relinquish control of their firms, and (2) the difficulty of transferring the firm due to the owners' embedded identity.

Table 2. Summary of IPOs in the Strategy Literature

Theoretical Perspective	Dependent Measures				
	Timing	Valuation / Pricing	Survival	Corporate Development	New Venture Founding
RBV		Cohen and Dean (2005) Nelson (2003) Filatochevand Bishop (2002) Certo, Cohen, Daily, and Dalton (2001) Certo, Daily, and Dalton (2001) Andrews and Welbourne (2000) Cyr, Johnson, and Welbourne (2000)	Andrews and Welbourne (2000)		
Social networks	Stuart, Hoang, and Hybels (1999)	Lester, Certo, Dalton, Dalton, and Cannella (2006) Pollock and Rindova (2003) Certo (2003) Gulati and Higgins (2003) Cyr et al. (2000) Stuart et al. (1999)	Fischer and Pollock (2004) Pollack, Porac, and Wade (2004)		
Population ecology	Shepherd and Zacharakis (2001)		Welbourne and Andrews (1996)		Stuart and Sorenson (2003)
Behavioral decision theory		Certo, Daily, Cannella, and Dalton (2003)			
Information economics				Reuer and Ragozzino (2005) Reuer and Shen (2004	

Table 3. Summary of IPOs in the Finance Literature—Financial Benefits

Aspect	Theoretical / Empirical Model	Support to Financial Benefits
Overcome financial constraints	Myers and Majluf (1984) Black and Gilson (1998) Lowry (2003) Clementi (2002)	IPOs can reduce information asymmetries between firms and financial providers, as well as allow firms to take advantage of favorable conditions. IPOs allow firms to overcome resource constraints that keep production at a suboptimal level.
Reduce financing costs	Bhattacharya and Ritter (1983) Amihud and Mendleson (1988) Diamond (1991) Rajan (1992) Booth and Chua (1996) Pagano and Röell (1998) Pagano, Panetta, and Zingales (1998) Chemmanur and Fulghieri (1999)	IPOs allow firms to obtain direct financing at lower cost by signaling their competencies, reducing their dependence on banks, or increase their bargaining power against banks.
Cash-out opportunity	Loughran, Ritter, and Rydqvist (1994) Zingales (1995) Pagano, Panetta, and Zingales (1998) Mello and Parsons (1998) Black and Gilson (1998) Stoughton and Zechner (1998)	IPOs provide cash-out/exit opportunities for both the entrepreneur and the venture capitalist.

Table 4. Summary of IPOs in the Finance Literature—Managerial Benefits

Aspect	Theoretical / Empirical Model	Support to managers
External monitoring and managerial incentives	Holmstrom and Tirole (1993) Burkart, Gromb and Panunzi (1997)	IPOs enhance firm performance through incentive alignments with stock-based contracts.
	Bolton and Von Thadden (1998)	IPOs eliminate problems with excessive monitoring by allowing the firm to establish a dispersed shareholder base of atomistic shareholders who do not monitor.
	Pagano and Röell (1998)	IPOs increase public monitoring of firms, forcing firms to engage in activities that enhance the firms' value.
Investment efficiency	Dow and Gorton (1997)	IPOs provide firms with essential information as stock market traders may have important information that managers do not have about the value of prospective investment opportunities.
	Ang, Cole, and Lin (2000) Maskowitz and Vissing-Jorgensen (2002)	Firms that undergo an IPO will make more effective decisions as private benefits of owners are eliminated.
Publicity and awareness	Maksimovic and Titman (1991) Rydqvist and Hogholm (1995) Pagano, Röell, and Zechner (2002) Ravasi and Marchisio (2003) Demers and Lewellen (2003)	IPOs enhance the visibility of firms.
Legitimacy	Marchisio and Ravasi (2001) Ritter and Welch (2002)	IPOs instill confidence in investors, customers, and suppliers.
Preparation for subsequent M&A	Rock (1994) Zingales (1995) Mello and Parsons (1998)	IPOs make it easier for a potential acquirer to identify a potential takeover target.
Shareholder diversification	Stoughton and Zechner (1998) Chemmanur and Fulghieri (1999)	Riskier firms can decrease the holding of the controlling shareholder through IPOs.

Table 5. Summary of IPOs in the Finance Literature—Competitive Benefits

Aspect	Theoretical / Empirical Model	Support to Competitive Strategy
Valuable growth opportunities	Myers (1977) Fischer (2000) Long, Wald, and Zhang (2003)	IPOs are followed by high investments in growth opportunities.
Preemption of resources	Schultz and Zaman (2001)	IPOs allow firms to acquire limited resources necessary for market expansion.
	Stoughton, Wong, and Zechner (1999)	Firms in high growth industries or small differences in productivity are likely to go public in order to gain market share.
Disclosure of information	Yosha (1995) Booth and Chua (1996) Chemmanuri and Fulghieri (1999) Subrahmanyam and Titman (1999)	Companies in which firm-specific information is important are less likely to have an IPO and reveal information.
	Maksimovic and Pichler (1998)	Firms in industries that are established or have high ratios of listed firms are likely to launch an IPO.
	Perotti and Von Thadden (2003)	High quality firms will face less aggression tactics from rivals.
Competitive behavior	Zingales (1980) Brander and Lewis (1986) Bolton and Scharfstein (1990) Phillips and Kovenock (1997) Khanna and Tice (2000)	IPOs reduce leverage allowing firms to compete aggressively through capital expansion.
	Kanatas and Qi (2001) Telser (1996) Bolton and Scharfstein (199) Fudenberg and Tirole (1986) Chavalier (1995)	Eliminates rivals' aggressive behavior such as price reduction and market expansion.

Table 6. Firm Actions and Strategic Considerations in the IPO Context

Driver	Type of Action	Subject	Key Resource / Determinant	IPO Context	Likelihood of IPO
Uncertainty	Entrepreneurial action	Small firms with low levels of VC involvement in their IPO decisions	Opportunity discovery through disequilibrium of information	IPOs brings about resources that can support growth derived from opportunities inherent in the market	High
	Real options reasoning	Firms with high levels of VC involvement / more rationality in their IPO decisions	Avoidance of large actions under unclear information	IPOs under uncertainty can bring about large opportunity costs that may deter firm growth	Low
Irreversibility	Real options reasoning	Firms undertaking large commitments under real options reasoning approach	Avoidance of action under unclear information that cannot be reversed	Irreversibility increases the negative effects of uncertainty on IPO	Low
Competition	Reactive	Firms that face high competition	Defense of resource platform and opportunities in the market Presence of blind spots	IPOs support firms in early movers advantage in resource acquisition	High
	Non-reactive / Avoidance of rivalry	Firms that face low competition or firms that may incur disadvantages from being reactive	Avoidance of rivalry in acquisition of resources and opportunities in the market Lack of blind spots	IPOs may be place firms at a disadvantage due to the potential leakage of information in the IPO launch	Low

Table 7. Comparison of Time Flow Approaches in IPO Launches

Time flow	Continuous	Punctuated
Source of opportunity	• Asymmetries of information	• Exogenous shocks
Source factors	• Product demand uncertainty • Stock return uncertainty	• Sudden large increases in product demand • Sudden large increases in stock returns
Criteria for evaluation	• Value of IPO launch based on entrepreneurial opportunities, deferral options, and competitive dynamics	• Value of difference between sudden shocks and benchmarks or long-term growth trends
Decision making	• Entrepreneurial action • Real options reasoning • VC involvement	• Decision making biases, usage of informational cues

Table 8. Summary of Relationships and Hypotheses

Relationships Between Variables			Hypotheses
Independent	**Moderator**	**Dependent**	
Product demand uncertainty		Choice / Likelihood of IPO Launch	H1A: *High uncertainty in product demand will increase the likelihood of IPO launch.*
Stock return uncertainty			H1B: *High uncertainty in stock returns will increase the likelihood of IPO launch.*
Product demand uncertainty			H2A: *High uncertainty in product demand will decrease the likelihood of IPO launch.*
Stock return uncertainty			H2B: *High uncertainty in stock returns will decrease the likelihood of IPO launch.*
Product demand uncertainty	Irreversibility		H3A: *High levels of irreversibility will increase the negative relationship between product demand uncertainty and the likelihood of IPO launch.*
Stock return uncertainty			H3B: *High levels of irreversibility will increase the negative relationship between stock return uncertainty and the likelihood of IPO launch.*
Product demand uncertainty / Stock return uncertainty	VC Involvement		H4: *Uncertainty will positively influence the likelihood of IPO when firms have low levels of involvement from VCs and negatively influence the likelihood of IPO when firms have high levels of involvement from VCs in their decision making.*
Product market competition			H5A: *High levels of product market competition will increase the likelihood of IPO launch.*
Competition in the IPO offerings market			H5B*: High levels of competition in the IPO offerings market will increase the likelihood of IPO launch.*
Product demand uncertainty	Product market competition		H6A: *The higher the level of product market competition, the level of product demand uncertainty will have a stronger negative effect on the likelihood of IPO launch.*
Stock return uncertainty	Competition in the IPO offerings market		*H6B: The higher the level of competition in the IPO offerings market, the level of stock uncertainty will have a stronger positive effect on the likelihood of IPO launch.*
Product demand shock			H7A: *The higher the increase in the product demand trend, the higher the likelihood of IPO launch.*
Stock return shock			*H7B: The higher the increase in stock market return trends, the higher the likelihood of IPO launch.*

Table 9. Industry Description

SIC	Description	SIC	Description
20	**Food and kindred products**	**35**	**Industrial machinery and equipment**
208	Malt beverages, wines and liquor, soft drinks, and flavoring extracts	351	Steam, gas, and hydraulic turbines
209	Food preparations	353	Construction machinery, elevators and moving stairways, trucks and tractors
		354	Machine tools, dies and power-driven handtools
		356	Pumps and compressors
		357	Computers
		358	Vending machines, air-conditioning and heating equipment, service industry machinery
		359	Carburetors, pistons, and valves
25	**Furniture and fixtures**	**36**	**Electrical and electronic equipment**
259	Drapery hardware and window shades	362	Motors and generators, electrical industrial apparatus
		365	Household audio and video equipment
		367	Electron tubes and semiconductors
		369	Batteries, magnetic and optical recording media
28	**Chemicals and allied products**	**38**	**Instruments and related products**
282	Plastics and synthetic resins, organic fibers	382	Laboratory apparatus and furniture, instruments for measuring and testing of electricity, laboratory analytical instruments, optical instruments and lenses
283	Medicinal chemicals and botanical products, pharmaceutical products	384	Medical instruments and apparatus, dental equipment and supplies , X-ray and electromedical apparatus
286	Gum and wood chemicals	385	Ophthalmic goods
287	Fertilizers	386	Photographic equipment and supplies
289	Adhesives and sealants, explosives, and printing ink		
32	**Stone, clay, glass, and concrete products**	**39**	**Miscellaneous manufacturing industries**
325	Brick and structural clay tile, ceramic wall and floor, clay refractories and products	393	Musical Instruments
		399	Brooms and brushes, signs and advertising specialties
33	**Primary metal industries**		
334	Secondary smelting and refining of nonferrous metals		
335	Rolling, drawing, and extruding of copper, aluminum sheet, plate, and foil		

Source: US Census Bureau

Table 10. Firm Descriptive Statistics I

	No. of Firms				No. of Firms With VC Funding				No. of Firms Without VC Funding			
SIC	Total	IPO	Dropped	Censured	Total	IPO	Dropped	Censured	Total	IPO	Dropped	Censured
208	39	9	7	23	13	2	4	7	26	7	3	16
209	76	9	26	41	25	4	11	10	51	5	15	31
259	13	5	1	7	2	1	-	1	11	4	1	6
282	23	3	8	12	8	1	2	5	15	2	6	7
283	445	236	94	115	264	164	61	39	181	72	33	76
286	32	11	7	14	20	7	5	8	12	4	2	6
287	7	4	2	1	2	2	-	-	5	2	2	1
289	6	3	2	1	4	2	1	1	2	1	1	-
299	1	-	1	-	-	-	-	-	1	-	1	-
325	15	3	3	9	10	3	2	5	5	-	1	4
334	28	10	8	10	13	5	5	3	15	5	3	7
335	42	14	11	17	12	6	4	2	30	8	7	15
351	2	1	-	1	1	1	-	-	1	-	-	1
353	37	3	12	22	10	-	3	7	27	3	9	15
354	39	3	9	27	7	-	1	6	32	3	8	21
355	1	-	1	-	1	-	1	-	-	-	-	-
356	41	5	13	23	12	2	3	7	29	3	10	16
357	372	107	126	139	222	76	87	59	150	31	39	80
358	68	11	22	35	23	5	10	8	45	6	12	27
359	64	7	13	44	16	2	5	9	48	5	8	35
362	21	6	4	11	10	4	1	5	11	2	3	6
365	19	8	8	3	5	-	5	-	14	8	3	3
367	366	129	117	120	192	82	68	42	174	47	49	78
369	66	14	17	35	30	9	13	8	36	5	4	27
382	173	31	57	85	94	20	39	35	79	11	18	50
384	505	179	136	190	280	122	84	74	225	57	52	116
385	21	6	6	9	7	4	2	1	14	2	4	8
386	2	2	-	-	1	1	-	-	1	1	-	-
393	10	3	3	4	4	2	-	2	6	1	3	2
399	105	7	27	71	17	1	6	10	88	6	21	61
Total	2,639	829	741	1,069	1,305	528	423	354	1,334	301	318	715

Table 11. Firm Descriptive Statistics II

		Ave. Firm Age at IPO (years)			Ave. VC Age at IPO (years)			Ave. Investments Held ($000)			Total Ave. Investments Held at IPO ($000)		
SIC	N	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
208	9	1.00	14.58	6.36	18.6	22.4	20.5	0	31,129	1,447	0	4,870	545
209	9	0.00	14.92	4.86	9.9	36.9	20.2	0	114,928	4,968	0	51,992	7,158
259	5	0.00	7.92	4.62	10.4	10.4	10.4	0	80,630	3,774	0	80,630	16,126
282	3	0.83	5.50	2.75	26.9	26.9	26.9	0	15,950	589	0	1,750	583
283	236	0.00	16.42	4.72	3.7	40.7	17.0	0	389,959	5,076	0	172,096	11,748
286	11	1.25	13.92	6.21	8.0	24.2	16.6	0	23,530	2,940	0	19,350	7,393
287	4	1.42	10.08	6.81	5.4	22.1	13.8	0	15,364	974	0	15,364	6,929
289	3	1.58	9.33	6.19	21.9	23.9	22.9	0	23,085	5,953	0	23,085	13,326
299	0	0.00	0.00	0.00	0.0	0.0	0.0	0	0	0	0	0	0
325	3	3.08	10.17	6.78	12.1	27.5	19.0	0	17,464	3,125	5,651	17,464	12,305
334	10	0.75	9.17	4.93	16.8	34.7	23.9	0	260,462	7,246	0	260,462	30,728
335	14	0.67	14.50	5.30	1.0	52.7	20.7	0	77,199	3,891	0	67,595	10,931
351	1	7.67	7.67	7.67	23.9	23.9	23.9	0	7,574	1,795	7,574	7,574	7,574
353	3	0.17	7.00	3.86	0.0	0.0	0.0	0	14,572	1,716	0	0	0
354	3	1.75	16.92	7.53	0.0	0.0	0.0	0	26,800	709	0	0	0
355	0	0.00	0.00	0.00	0.0	0.0	0.0	8,800	8,800	8,800	0	0	0
356	5	2.42	13.08	6.80	16.8	30.1	23.4	0	10400	552	0	1,450	463
357	107	0.00	16.92	5.18	0.0	40.6	15.8	0	145,000	4,900	0	145,000	14,640
358	11	1.42	8.50	4.19	8.2	29.4	17.0	0	17,033	1,316	0	14,001	4,387
359	7	0.58	9.83	3.32	8.8	13.3	11.1	0	40,088	982	0	24,840	3,763
362	6	1.33	10.00	5.50	10.4	22.3	17.9	0	26,500	3,534	0	26,500	7,020
365	8	2.58	14.92	5.60	13.6	32.4	22.5	0	16,000	1,410	0	16,000	2,916
367	129	0.00	15.00	6.26	3.1	52.1	21.4	0	5,469	0	0	120,000	11,872
369	14	0.25	13.75	5.66	8.3	29.1	20.0	0	148,926	2,371	0	58,275	8,895
382	31	0.33	13.67	6.47	5.3	39.8	22.0	0	43,631	3,236	0	25,486	7,823
384	179	0.17	15.50	5.27	0.0	51.2	18.7	0	304,000	4,437	0	146,289	10,034
385	6	1.50	12.92	7.31	9.3	25.3	20.4	0	30,700	1,667	0	30,700	8,338
386	2	2.50	3.75	3.13	18.5	18.5	18.5	0	13,300	2,236	0	13,300	6,650
393	3	2.17	3.50	2.66	10.6	12.3	11.4	0	7,730	1,165	0	7,730	4,895
399	7	0.50	12.83	4.23	7.7	7.7	7.7	0	61,500	1,277	0	1,210	173
Summary	829	0.00	16.92	5.01	0.00	52.70	16.12	0	389,959	2,736	0	260,462	7,241

Table 12. Industry Descriptive Statistics: Level of Uncertainty

		Product Demand Uncertainty				Stock Returns Uncertainty				Comparison
SIC	N	Min	Max	Std Dev	Mean	Min	Max	Std Dev	Mean	of Means (F)
208	204	0.111	0.991	0.302	0.386	0.384	0.881	0.112	0.492	22.03 **
209	204	0.000	0.404	0.153	0.203	0.000	0.001	0.000	0.000	358.97 **
259	204	0.000	0.272	0.081	0.032	0.000	0.808	0.237	0.082	8.11 **
282	192	0.000	0.662	0.173	0.136	0.000	0.886	0.418	0.533	184.15 **
283	204	0.000	0.586	0.178	0.134	0.723	0.813	0.024	0.760	381.46 **
286	195	0.000	0.000	0.000	0.000	0.526	0.915	0.030	0.555	2469.76 **
287	173	0.000	0.528	0.196	0.168	0.000	0.000	0.000	0.000	114.18 **
289	204	0.171	0.915	0.247	0.453	0.677	0.808	0.044	0.759	114.18 **
325	192	0.000	0.463	0.180	0.183	0.000	0.535	0.245	0.244	17.31 **
334	192	0.000	0.864	0.339	0.394	0.000	0.901	0.437	0.522	10.66 **
335	204	0.000	0.863	0.388	0.419	0.000	0.000	0.000	0.000	237.72 **
351	132	0.000	0.925	0.346	0.163	0.000	0.000	0.000	0.000	103.05 **
353	204	0.000	0.067	0.021	0.013	0.000	0.853	0.394	0.468	103.05 **
354	204	0.000	0.701	0.205	0.351	0.000	0.001	0.000	0.000	599.76 **
356	204	0.000	0.931	0.327	0.286	0.000	0.925	0.417	0.280	0.03
357	204	0.000	0.959	0.344	0.209	0.000	0.763	0.173	0.045	36.74 **
358	204	0.139	0.917	0.264	0.370	0.000	0.922	0.443	0.511	15.22 **
359	204	0.000	0.302	0.123	0.112	0.000	0.001	0.000	0.000	170.50 **
362	203	0.000	0.974	0.257	0.099	0.596	0.732	0.025	0.671	1005.44 **
365	201	0.000	0.999	0.365	0.685	0.000	0.473	0.075	0.360	161.93 **
367	204	0.000	0.004	0.001	0.000	0.000	0.822	0.272	0.104	29.59 **
369	204	0.000	0.274	0.089	0.048	0.000	0.001	0.000	0.001	57.41 **
382	204	0.000	0.052	0.012	0.005	0.000	0.915	0.091	0.017	3.74
384	204	0.000	0.000	0.000	0.000	0.084	0.666	0.256	0.350	381.46 **
385	169	0.000	0.930	0.362	0.264	0.000	0.106	0.015	0.007	164.82 **
386	77	0.000	0.298	0.114	0.094	0.000	0.000	0.000	0.000	201.73 **
393	173	0.000	0.678	0.235	0.434	0.000	0.000	0.000	0.000	531.78 **
399	192	0.000	0.983	0.414	0.554	0.000	0.000	0.000	0.000	311.40 **

p<0.05; **p<0.01

Note: N=No. of month periods for level of uncertainty measures from the GARCH model used in the likelihood of IPO model. The uncertainty measures depict the conditional variances of the product market demand or stock returns in each industry at the SIC 3-digit level. Values of zero or close to zero depict very low levels of uncertainty or conditions and outcomes that can be predicted from previous trends in the past. Values of one or close to one depict very high levels of uncertainty or conditions and outcomes that cannot be predicted from previous trends in the past.

Table 13. Industry Descriptive Statistics: Competition and Reversibility

		Product Market Competition				Stock Market Competition				No. of
SIC	N	Min	Max	Std Dev	Mean	Min	Max	Std Dev	Mean	LBOs/MBOs
208	204	0.822	0.894	0.022	0.844	0	16	4.2	5.3	23
209	204	0.566	0.723	0.051	0.653	0	16	4.2	5.3	13
259	204	0.181	0.574	0.116	0.325	0	7	1.8	1.4	4
282	192	0.560	0.796	0.064	0.672	6	53	14.0	24.6	17
283	204	0.935	0.954	0.006	0.944	6	53	14.2	23.7	16
286	195	0.751	0.905	0.054	0.843	6	53	14.1	24.4	10
287	173	0.654	0.907	0.082	0.819	6	53	14.1	26.0	8
289	204	0.808	0.898	0.034	0.852	6	53	14.2	23.7	19
325	192	0.395	0.734	0.087	0.605	0	4	1.3	1.4	3
334	192	0.005	0.603	0.170	0.342	0	14	3.8	3.8	4
335	204	0.727	0.856	0.034	0.781	0	14	3.7	3.7	17
351	132	0.718	0.800	0.024	0.777	10	39	10.2	24.7	2
353	204	0.791	0.869	0.022	0.819	10	80	16.0	29.2	18
354	204	0.814	0.912	0.031	0.861	10	80	16.0	29.2	23
356	204	0.613	0.862	0.082	0.734	10	80	16.0	29.2	27
357	204	0.871	0.925	0.013	0.893	10	80	16.0	29.2	31
358	204	0.544	0.867	0.096	0.722	10	80	16.0	29.2	23
359	204	0.538	0.812	0.075	0.691	10	80	16.0	29.2	10
362	203	0.339	0.674	0.095	0.487	7	77	19.5	31.0	17
365	201	0.411	0.798	0.119	0.651	7	77	19.6	31.1	7
367	204	0.849	0.936	0.027	0.911	7	77	19.5	30.9	47
369	204	0.574	0.911	0.110	0.785	7	77	19.5	30.9	9
382	204	0.851	0.940	0.026	0.891	11	66	16.3	27.6	32
384	204	0.847	0.957	0.030	0.898	11	66	16.3	27.6	39
385	169	0.278	0.772	0.150	0.560	11	66	17.1	28.5	6
386	77	0.645	0.756	0.037	0.697	11	66	20.5	35.3	6
393	173	0.000	0.492	0.215	0.189	0	12	3.8	5.3	5
399	192	0.406	0.875	0.180	0.716	0	12	3.9	5.4	9

Note:
1. N=No. of months
2. Product market competition depicts the Blau Index (1-Herfindahl Index) at the 3-digit SIC code.
3. Stock market competition depicts the number of IPO offerings that occurred during each year period at the 2-digit SIC code.
4. The no. of leverage buy-outs (LBOs)/management buy-outs (MBOs) depicts the number of leverage buyouts or management buyouts that occurred during each year period.

Table 14. Industry Descriptive Statistics: Market-to-Book Ratio and Book Value of Debt

		Market-to-Book Ratio				Total Book Value of Debt (US$mn)			
SIC	N	Min	Max	Std Dev	Mean	Min	Max	Std Dev	Mean
208	204	1.132	9.514	2.067	3.628	191.786	1,397.462	305.388	730.530
209	204	1.531	5.866	1.101	3.134	15.284	110.726	28.021	47.445
259	204	0.485	4.131	0.758	1.559	9.564	96.135	26.443	49.952
282	192	1.011	5.117	0.992	2.748	541.708	1,321.728	243.161	816.814
283	204	0.691	3.673	0.762	1.867	95.988	278.222	58.456	168.266
286	195	1.880	6.399	1.278	3.850	327.680	839.907	171.807	596.571
287	173	0.737	3.187	0.729	1.981	60.426	344.383	72.255	213.453
289	204	1.032	3.841	0.608	2.073	62.595	208.286	50.803	122.563
325	192	1.197	3.454	0.613	2.209	19.418	139.454	30.677	51.007
334	192	0.661	2.914	0.420	1.232	8.414	82.604	20.420	25.028
335	204	0.361	3.660	0.901	1.568	170.576	518.975	104.646	320.399
351	132	0.620	2.283	0.367	1.197	121.718	318.702	66.203	194.489
353	204	0.807	2.609	0.393	1.583	110.635	524.320	164.960	281.817
354	204	0.890	2.977	0.525	1.662	35.224	354.672	129.454	175.120
356	204	0.951	2.702	0.431	1.710	103.054	394.025	117.766	200.892
357	204	0.673	3.909	0.574	1.346	113.702	885.289	280.010	392.913
358	204	1.411	4.137	0.511	2.080	46.917	190.185	42.180	76.409
359	204	0.718	2.686	0.459	1.536	2.653	31.636	10.414	16.708
362	203	0.541	3.534	0.640	1.870	18.998	135.194	30.873	58.705
365	201	1.000	3.070	0.533	1.848	135.042	1,330.955	458.507	683.715
367	204	1.161	2.879	0.369	1.730	21.761	90.628	21.071	50.261
369	204	1.503	3.861	0.507	2.394	23.267	97.422	23.585	44.421
382	204	1.213	3.278	0.477	1.996	19.364	65.842	13.579	35.592
384	204	1.369	4.533	0.818	2.386	28.657	72.146	14.609	51.124
385	169	0.998	7.641	1.503	2.916	3.365	141.374	49.049	47.926
386	77	1.369	4.825	1.026	2.231	50.002	1,203.482	432.499	482.636
393	173	0.507	3.066	0.491	1.059	0.248	93.296	31.561	31.752
399	192	0.632	7.686	1.591	2.261	16.764	112.666	29.789	55.211

Table 15. Overall Descriptive Statistics for All Industries

Variable	N	Mean	Std Dev	Minimum	Maximum
Firm Age	211,627	1.142	1.0723	-2.4849	2.8283
VC Age	211,627	1.065	1.3720	-5.6204	3.9646
MB Ratio	211,627	0.647	1.1399	-1.5832	7.5690
Investments	211,627	3,772	12,221	0	389,959
Bank Debt	211,627	-322.09	159.5	-516.2	2,656.0
Product demand uncertainty	211,627	0.112	0.2437	-0.2251	0.7737
Stock return uncertainty	211,627	0.061	0.3261	-0.2048	0.7201
Reverrsibility	211,627	0.109	0.2932	-0.9300	2.0702
Product market competition	211,627	0.170	0.1216	-0.6804	0.2768
Stock market competition	211,627	15.292	16.8296	-8.8852	70.1148
Product demand shock	211,627	1.311	0.1342	0	30.6874
Stock market shock	211,627	3.055	4.0144	0	1.2169

Note: The results show mean-centered variables for industry-wide time varying covariates: product demand uncertainty, stock return uncertainty, reversibility, product market competition, and competition in the IPO offerings market (or stock market competition). All centering for industry-wide time varying covariates were conducted prior to constructing the database model across the 204-month time period. This was conducted in order to avoid bias that may come from having an unbalanced number of observations in any particular period. For this reason, variables such as Firm Age, VC Age, and Investments were not centered, as they exist only in the database model across the 204-month period. The values for Firm Age and VC Age depict the log transformed values.

Table 16. Correlations

	1	2	3	4	5	6	7	8	9	10	11	12
1 Product demand uncertainty	1											
2 Stock return uncertainty	0.02538	1										
3 Reversibility	-0.01743	-0.05659	1									
4 Product market competition	-0.25234	0.07536	-0.07297	1								
5 Stock market competition	-0.09949	0.16087	-0.11389	0.25375	1							
6 Product demand shock	-0.23695	-0.10089	-0.01809	0.25133	0.05731	1						
7 Stock market shock	0.01199	-0.01499	0.02124	-0.03952	0.25939	-0.06444	1					
8 Firm Age	-0.09243	-0.09141	0.11454	0.03694	-0.00653	0.09858	0.05075	1				
9 VC Age	-0.10691	0.00631	0.02750	0.09916	0.02162	0.09421	-0.01735	0.27458	1			
10 Investments	-0.05488	0.00195	0.01882	0.05657	0.02851	0.05613	-0.0059	0.9810	0.38942	1		
11 MB Ratio	-0.09721	0.34522	0.11589	0.27517	0.26074	-0.09088	0.37869	0.09875	0.04084	0.06652	1	
12 Debt Level	-0.05907	0.07605	0.13227	-0.15916	-0.06281	0.04094	0.06406	0.19457	0.0407	0.02875	0.27781	1

Table 17. Variance Inflation Tests

Variable	Parameter Estimate	Standard Error	t-value	Pr > |t|	Variance Inflation
Intercept	198967	2.12447	93654.6	<.0001	0
Product demand uncertainty	-201.52071	2.88188	-69.93	<.0001	1.13088
Stock return uncertainty	-232.36304	2.28220	-101.82	<.0001	1.28739
Reversibility	56.18385	2.56214	21.93	<.0001	1.09226
Product market competition	-168.61525	6.27866	-26.86	<.0001	1.44118
Stock market competition	2.17392	0.04402	49.38	<.0001	1.20941
Product demand shock	-137.92752	5.68844	-24.25	<.0001	1.32854
Stock market shock	6.56305	0.17839	36.79	<.0001	1.17574
Firm Age	112.97152	0.66769	169.2	<.0001	1.17501
VC Age	-10.76991	0.54068	-19.92	<.0001	1.27202
Investments	0.00058274	0.00006	10.49	<.0001	1.17211
MB Ratio	151.20571	0.75484	200.31	<.0001	1.84480
Debt Level	0.67507	0.00461	146.41	<.0001	1.25607

Table 18. Collinearity Diagnostics

	Eigen-value	Condition Index	Intercept	P-Uncer	S-Uncer	Revers	P-Comp	S-Comp	P-Shock	S-Shock	Firm Age	VC Age	Invest	MB Ratio	Bank Debt
1	5.9984	1.0000	0.0023	0.0058	0.0003	0.0034	0.0050	0.0072	0.0068	0.0061	0.0068	0.0068	0.0034	0.0044	0.0032
2	1.2970	2.1506	0.0002	0.0088	0.3163	0.0001	0.0001	0.0062	0.0268	0.0085	0.0045	0.0099	0.0137	0.0828	0.0017
3	1.0166	2.4291	0.0009	0.0085	0.0173	0.0734	0.0054	0.0195	0.0126	0.0096	0.0021	0.0662	0.4302	0.0029	0.0057
4	0.9350	2.5328	0.0002	0.0266	0.0607	0.5501	0.0055	0.0047	0.0108	0.0173	0.0093	0.0083	0.0854	0.0059	0.4176
5	0.8266	2.6939	0.0014	0.4822	0.0403	0.0809	0.0009	0.0159	0.0511	0.0679	0.0007	0.0024	0.0189	0.8256	0.0092
6	0.6618	3.0106	0.0045	0.2191	0.2076	0.0401	0.0049	0.0049	0.0553	0.1430	0.0043	0.0117	0.0511	0.0742	0.0165
7	0.5151	3.4124	0.0000	0.0129	0.0014	0.1092	0.0044	0.0730	0.0929	0.0002	0.2376	0.2367	0.2360	0.0039	0.0048
8	0.4754	3.5521	0.0038	0.1403	0.0019	0.0329	0.0025	0.0465	0.5987	0.0358	0.0269	0.0028	0.0000	0.0601	0.0487
9	0.3613	4.0746	0.0067	0.0113	0.0835	0.0247	0.1190	0.3564	0.0331	0.0923	0.0032	0.1461	0.0264	0.1908	0.0244
10	0.3525	4.1254	0.0076	0.0422	0.0991	0.0000	0.0207	0.4401	0.0094	0.3247	0.1342	0.0178	0.0004	0.0420	0.0409
11	0.3327	4.2460	0.0033	0.0304	0.1213	0.0061	0.0419	0.0016	0.0044	0.0201	0.4339	0.4876	0.1328	0.1037	0.0014
12	0.1595	6.1332	0.0330	0.0107	0.0435	0.0408	0.7893	0.0240	0.0604	0.2574	0.0080	0.0004	0.0017	0.3932	0.1231
13	0.0682	9.3768	0.9360	0.0011	0.0067	0.0382	0.0005	0.0000	0.0379	0.0171	0.1285	0.0031	0.0001	0.0354	0.7200

Note: P-Uncer = product demand uncertainty; S-Uncer = stock return uncertainty; Revers = reversibility; P-Comp = product market competition; S-Comp = competition in the IPO offerings market; P-Shock = product demand shock; and S-Shock = stock market shock.

Table 19. Parameter Estimates for Likelihood of IPO (Model 1 - Model 4)

	Control Model		Uncertainty Models					
	Model 1		Model 2		Model 3		Model 4	
Variable	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio
Firm Age	0.0401	1.041	0.0487	1.05	0.0527	1.054	0.0585	1.060
VC Age	0.2960 ***	1.344	0.28854 ***	1.334	0.29129 ***	1.338	0.2859 ***	1.331
Investments	0.0000 ***	1.000	5.34E-06 ***	1.000	5.47E-06 ***	1.000	5.40E-06 ***	1.000
MB Ratio	0.3138 ***	1.369	0.3202 ***	1.377	0.2340 ***	1.264	0.2396 ***	1.271
Bank Debt	-0.0005 *	0.999	-0.0005 *	1.000	-0.0008 *	0.999	-0.0008 **	0.999
P-Uncer			-0.4371 *	0.646			-0.3466 +	0.707
S-Uncer					0.5868 ***	1.798	0.5636 ***	1.757
Reversibility								
P-Comp								
S-Comp								
S-Uncer x Irr								
P-Uncer x Investments								
S-Uncer x Investments								
P-Uncer x P-Comp								
S-Uncer x S-Comp								
P-Shock								
S-Shock								
R-Squared	0.4078		0.4269		0.4357		0.4522	
Likelihood Ratio	326.568		332.502		350.029		353.698	
Base Model Comparison			Model 1		Model 1		Model 1	
Likelihood Ratio Test			11.87 ***		46.92 ***		54.26 ***	
No. of Observations	211,627		211,627		211,627		211,627	
No. of IPO events	829		829		829		829	

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Note: There are no intercepts in the likelihood of IPO models, which is a characteristic of partial likelihood estimates (Allison, 1995). This is because the intercept is an arbitrary function of time (depicted in the baseline model in Figure 4), which is cancelled out from the estimating equations in the model. The hazard ratio is the estimated percentage change in likelihood of IPO for one unit increase in the covariate. The likelihood of IPO can be obtained by subtracting 1.0 from the hazard ratio and multiplying it by 100. For example, in Model 1, an increase in Firm Age by one unit will yield an additional increase of likelihood of IPO by 4.1 % (1-1.041) x 100.

Table 20. Parameter Estimates for Likelihood of IPO (Model 5 - Model 8)

	Irreversibility Model		Autonomy Models					
	Model 5		Model 6		Model 7		Model 8	
Variable	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio
Firm Age	0.0526	1.054	0.0504	1.038	0.0535	1.055	0.0606	1.062
VC Age	0.29119 ***	1.338	0.28086 ***	1.334	0.28776 ***	1.333	0.27549 ***	1.317
Investments	5.49E-06 ***	1.000	1.27E-05 ***	1.000	6.93E-06 ***	1.000	1.39E-05 ***	1.000
MB Ratio	0.2379 ***	1.269	0.3203 ***	1.361	0.2361 ***	1.266	0.2388 ***	1.27
Bank Debt	-0.0008 +	0.999	-0.0005 **	1.000	-0.0008 **	0.999	-0.0008 **	0.999
P-Uncer			-0.6258 **	0.707			-0.5333 **	0.587
S-Uncer	0.5657 ***	1.761			0.6339 ***	1.885	0.6169 ***	1.853
Reversibility	-0.3016	0.74						
P-Comp								
S-Comp								
S-Uncer x Irr								
P-Uncer x Investments			3.41E-05 ***	1.000			3.39E-05 ***	1.000
S-Uncer x Investments					-5.23E-06 +	1.000	-4.15E-06	1.000
P-Uncer x P-Comp								
S-Uncer x S-Comp								
P-Shock								
S-Shock								
R-Squared	0.4102		0.4276		0.4102		0.4531	
Likelihood Ratio	352.236		340.450		353.577		364.950	
Base Model Comparison	Model 3		Model 2		Model 3		Model 4	
Likelihood Ratio Test	4.41 ***		15.90 ***		7.10 ***		22.50 ***	
No. of Observations	211,627		211,627		211,627		211,627	
No. of IPO events	829		829		829		829	

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 21. Parameter Estimates for Likelihood of IPO (Model 9 - Model 13)

	Competition Models									
	Model 9		Model 10		Model 11		Model 12		Model 13	
Variable	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio	Parameter Estimates	Hazard Ratio
Firm Age	0.0417	1.043	0.0467	1.048	0.0526	1.054	0.0606	1.063	0.0065	1.054
VC Age	0.29045 ***	1.337	0.2893 ***	1.335	0.28336 ***	1.328	0.28697 ***	1.332	0.28247 ***	1.328
Investments	5.43E-06 ***	1.000	5.35E-06 ***	1.000	5.33E-06 ***	1.000	5.28E-06 ***	1.000	5.24E-06 ***	1.000
MB Ratio	0.2941 ***	1.342	0.3003 ***	1.350	0.3023 ***	1.353	0.2193 ***	1.245	0.2188 ***	1.353
Bank Debt	-0.0004 +	1.000	-0.0004 +	1.000	-0.0003 +	1.000	-0.0007 +	0.999	-0.0006 *	1.000
P-Uncer					0.1320	1.141			0.1407	1.151
S-Uncer							0.1320 +	1.358	0.2351	1.265
Reversibility										
P-Comp	0.7804 +	2.182			0.4750	1.608			0.3500	1.419
S-Comp			0.0067 *	1.007			0.0058 *	1.006	0.0032	1.265
S-Uncer x Irr										
P-Uncer x Investments										
S-Uncer x Investments										
P-Uncer x P-Comp					-3.3951 **	0.034			-2.34E+00 *	0.096
S-Uncer x S-Comp							0.0113 *	1.011	1.21E-02 *	1.012
P-Shock										
S-Shock										
R-Squared	0.4081		0.4112		0.4389		0.4452		0.4914	
Likelihood Ratio	330.698		332.548		341.545		359.847		365.156	
Base Model Comparison	Model 1		Model 1		Model 9		Model 10		Model 1	
Likelihood Ratio Test	8.26 ***		11.96 ***		21.69 ***		54.60 ***		77.18 ***	
No. of Observations	211,627		211,627		211,627		211,627		211,627	
No. of IPO events	829		829		829		829		829	

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 22. Parameter Estimates for Likelihood of IPO (Model 14 - Model 15)

	Cummulative Time Flow Model			Puntuated Time Flow Model		
	Model 14			Model 15		
Variable	Parameter Estimates		Hazard Ratio	Parameter Estimates		Hazard Ratio
Firm Age	0.0670		1.069	0.0386		1.039
VC Age	0.27128	***	1.312	0.29299	***	1.340
Investments	1.39E-05	***	1.000	5.44E-06	***	1.000
MB Ratio	0.2221	***	1.249	0.3299	***	1.391
Bank Debt	-0.0005	+	0.999	-0.0005	+	0.999
P-Uncer	0.0066		1.007			
S-Uncer	0.3807	+	1.463			
Reversibility	0.0318		1.032			
P-Comp	0.3410		1.406			
S-Comp	0.0029		1.003			
S-Uncer x Irr	-0.9628		0.382			
P-Uncer x Investments	3.37E-05	***	1.000			
S-Uncer x Investments	-4.83E-06	*	1.000			
P-Uncer x P-Comp	-2.76E+00	*	0.063			
S-Uncer x S-Comp	1.12E-02	+	1.011			
P-Shock				2.15E-01	*	1.022
S-Shock				8.25E-03		1.008
R-Squared	0.4952			0.4206		
Likelihood Ratio	381.568			330.614		
Base Model Comparison	Model 1			Model 1		
Likelihood Ratio Test	110.00	***		8.09	***	
No. of Observations	211,627			211,627		
No. of IPO events	829			829		

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 23. Summary of Results

Hypotheses	Results
H1A: *High uncertainty in product demands will increase the likelihood of IPO launch.*	**NOT SUPPORTED**: Results supported counter Hypothesis2A
H1B: *High uncertainty in stock returns will increase the likelihood of IPO launch.*	**SUPPORTED**
H2A: *High uncertainty in product demands will decrease the likelihood of IPO launch.*	**SUPPORTED**
H2B: *High uncertainty in stock returns will decrease the likelihood of IPO launch.*	**NOT SUPPORTED**: Results supported counter Hypothesis1B
H3: *High levels of irreversibility will increase the negative relationship between product demand uncertainty and the likelihood of IPO launch.*	**NOT SUPPORTED**
H4: *Uncertainty will positively influence the likelihood of IPO when firms have low levels of influence from VCs and negatively influence the likelihood of IPO when firms have high levels of influence from VCs in their decision making.*	**MIXED SUPPORT**: Results not supported for product market. However, partially supported for stock market.
H5A: *High levels of product market competition will increase the likelihood of IPO launch.*	**SUPPORTED**
H5B: *High levels of competition in the IPO offerings market will increase the likelihood of IPO launch.*	**SUPPORTED**
H6A: *The higher the level of product market competition, the level of product demand uncertainty will have a stronger negative effect on the likelihood of IPO launch.*	**SUPPORTED**
H6B: *The higher the level of competition in the IPO offerings market, the level of stock uncertainty will have a stronger positive effect on the likelihood of IPO launch.*	**SUPPORTED**
H7A: *The higher the increase in the product demand trend, the higher the likelihood of IPO launch.*	**SUPPORTED**
H7B: The higher the increase in stock market return trends, the higher the likelihood of IPO launch.	**NOT SUPPORTED**

Figure 1. Proposed Research Model

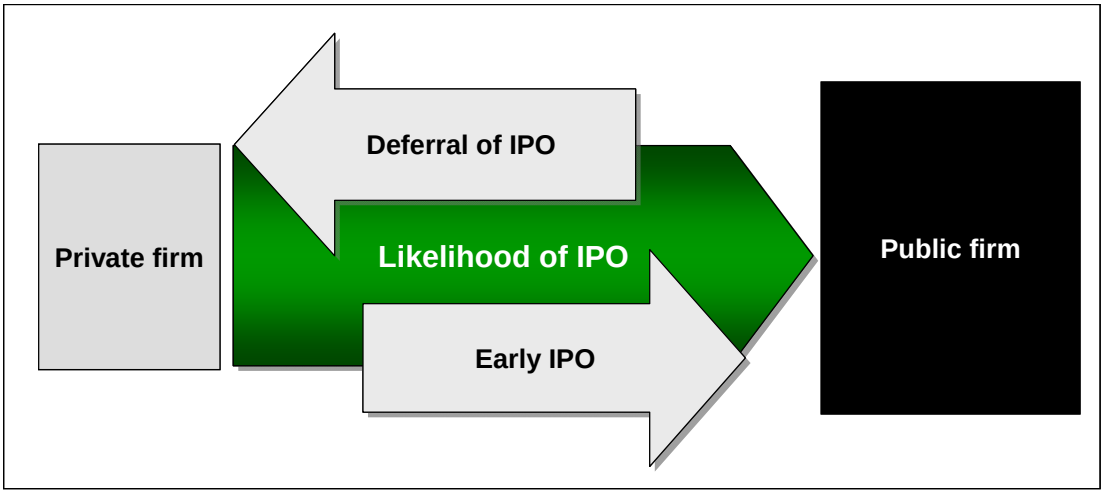


Figure 2. Model and Hypothesized Relationships (Continuous Time Flow)

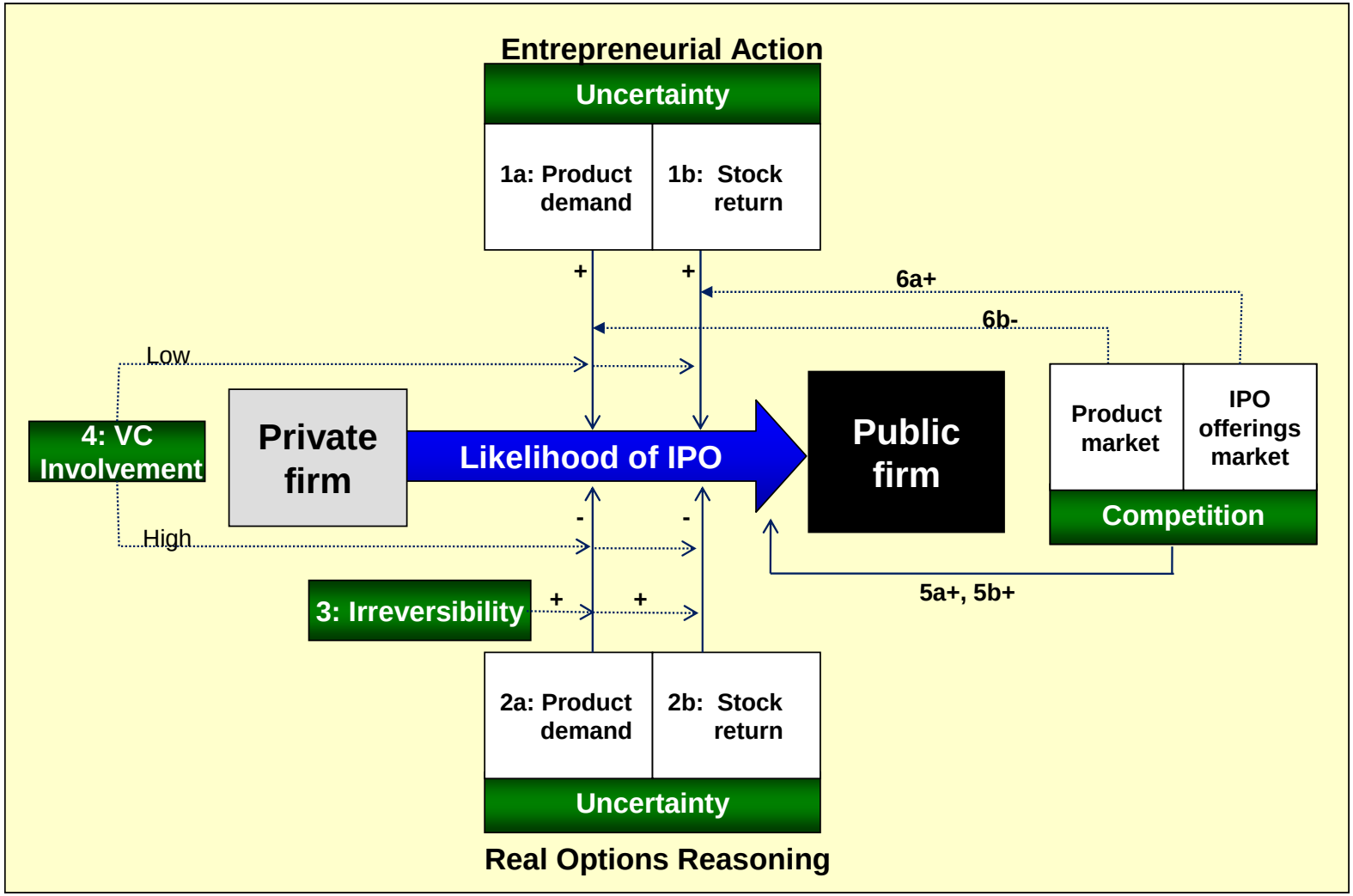


Figure 3. Model and Hypothesized Relationships (Punctuated Time Flow)

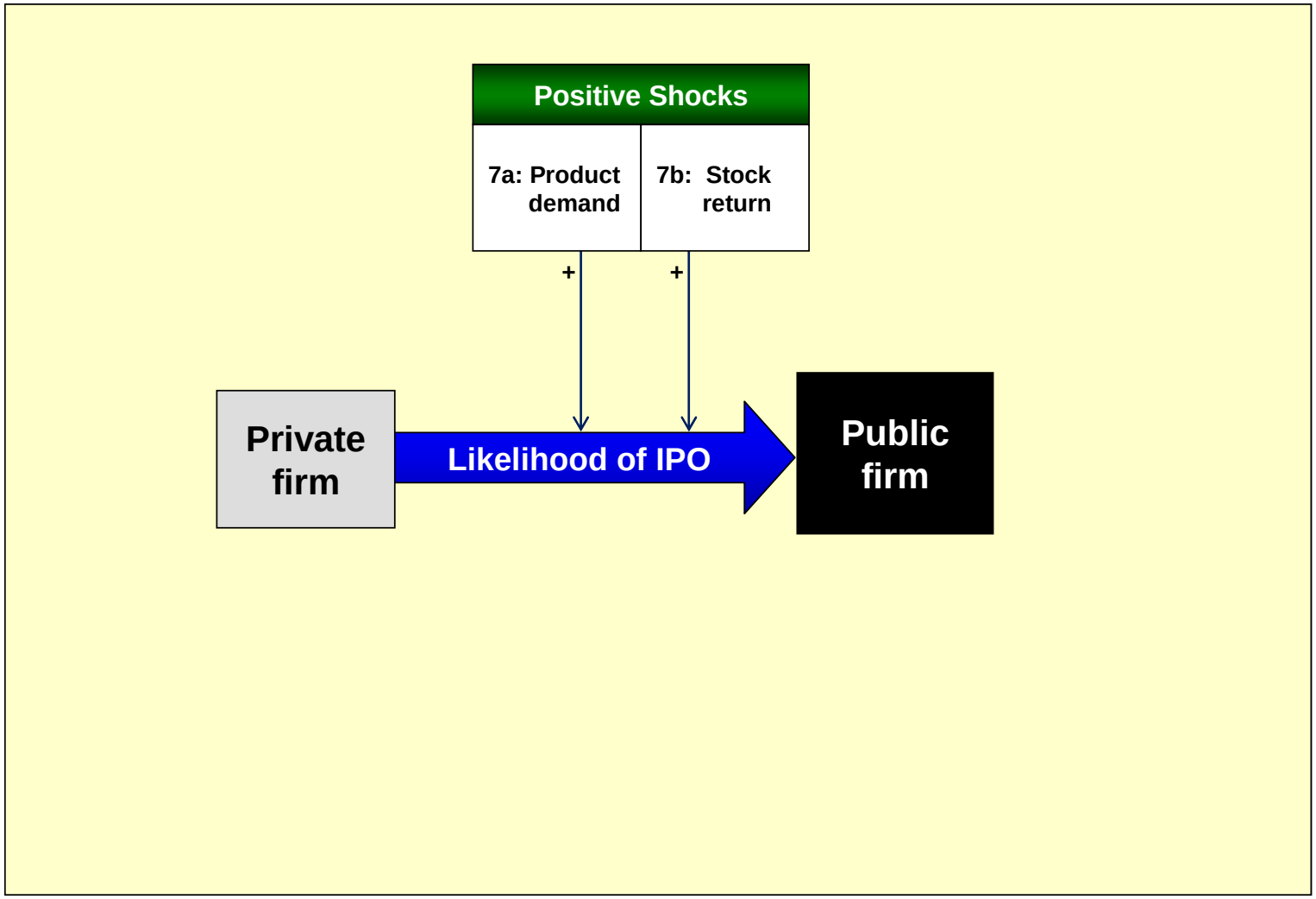
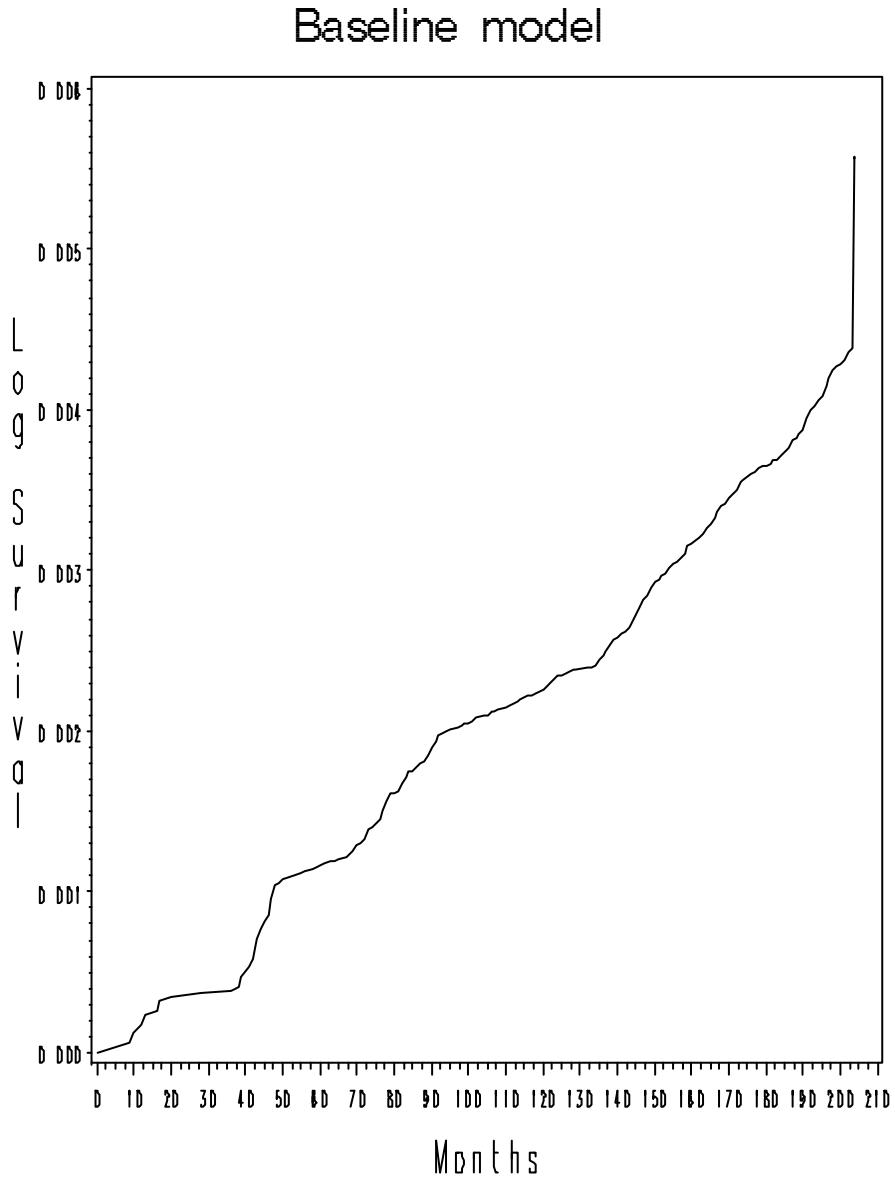
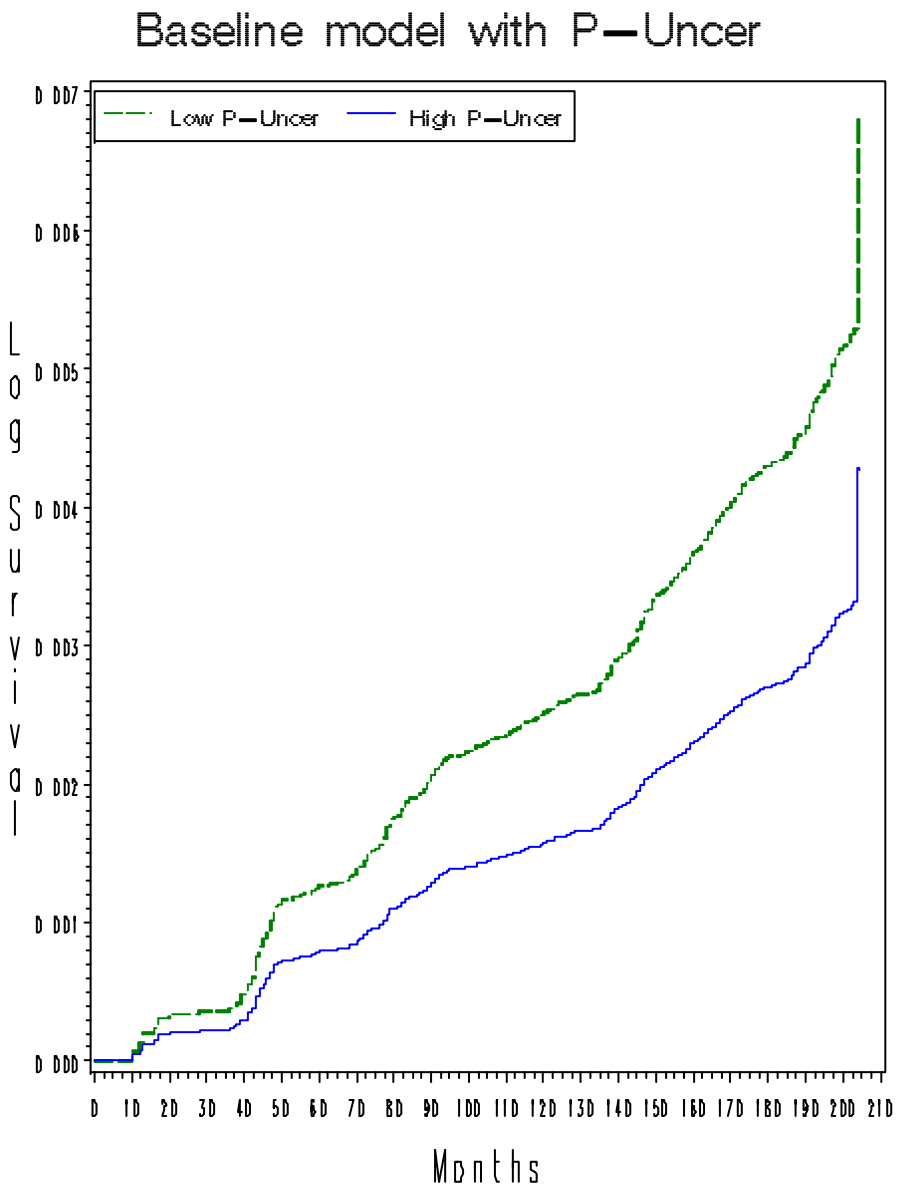


Figure 4. Likelihood of IPO (Baseline Model)



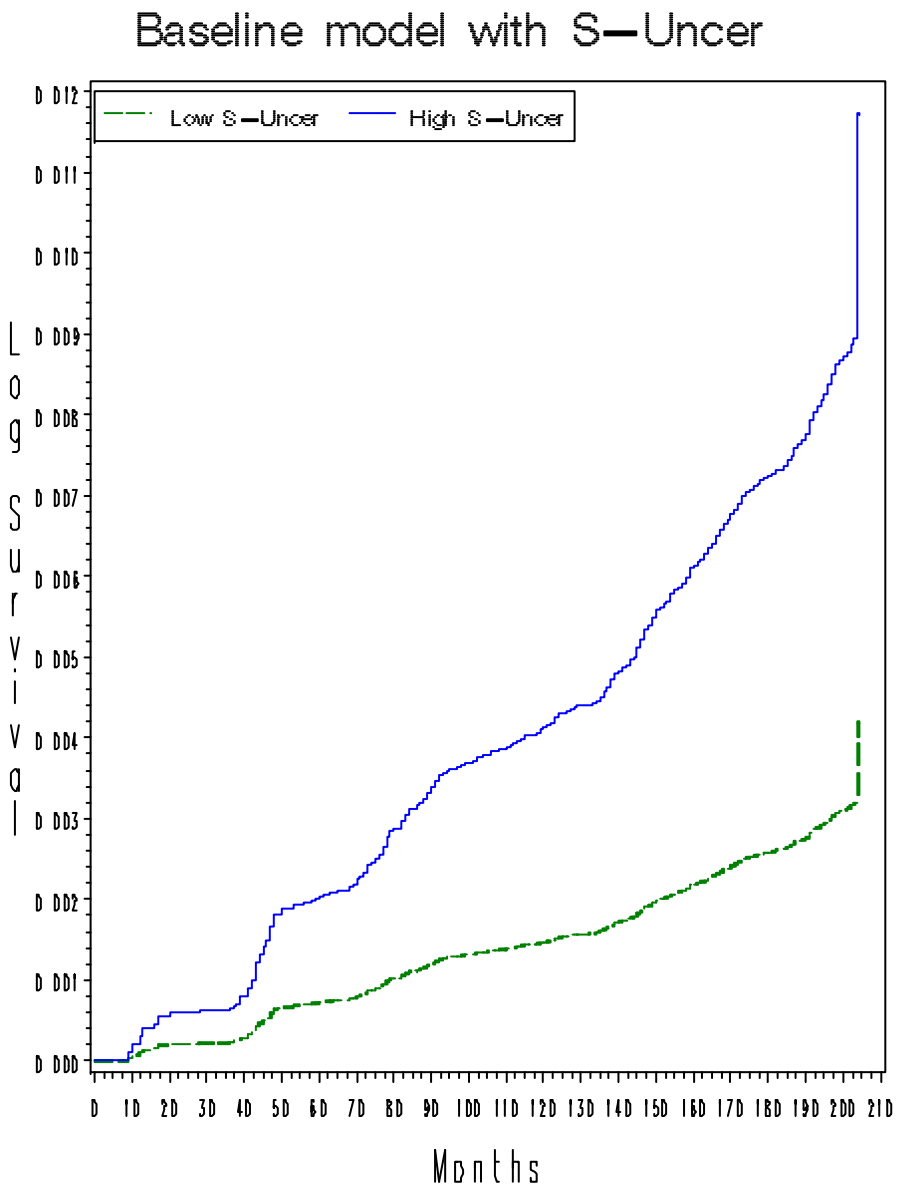
Note: This baseline model depicts the cumulative function of IPO likelihood across time under the assumption that all covariates are zero. In other words, this baseline model describes the cumulative probability that a firm will launch an IPO, assuming that there are no exogenous influences.

Figure 5. The Effect of Product Demand Uncertainty on Likelihood of IPO



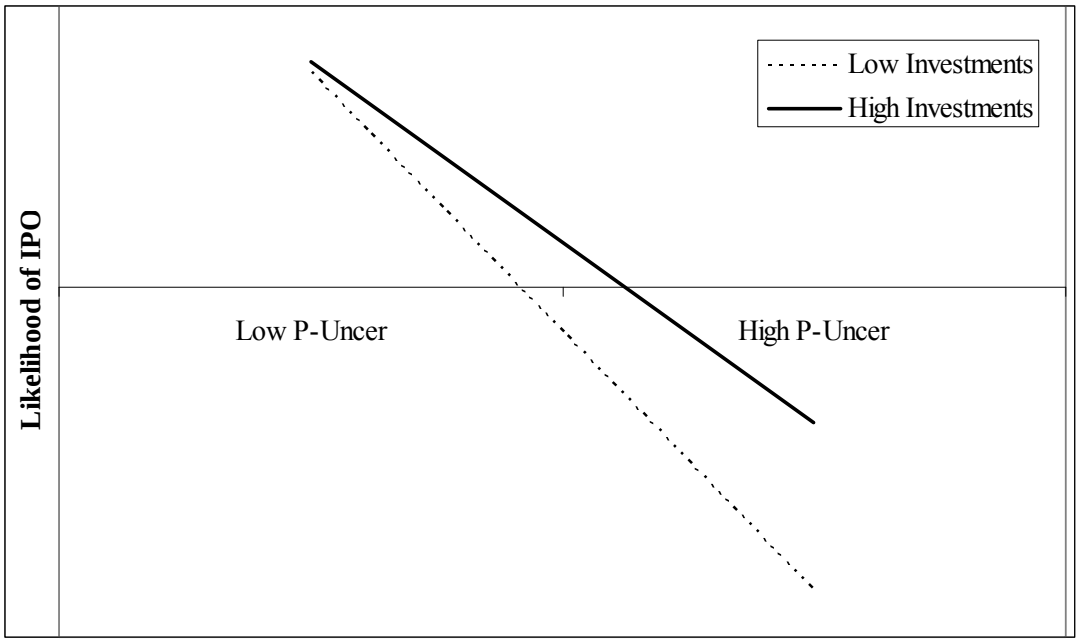
Note: This baseline model with P-Uncer depicts the influence of product demand uncertainty at two levels of uncertainty (10^{th} percentile and 90^{th} percentile) on the cumulative function of IPO likelihood across time, under the assumption that all other covariates are zero. Product demand uncertainty at the 10^{th} percentile is labeled as 'Low P-Uncer' and product demand uncertainty at the 90^{th} percentile is labeled as 'High P-Uncer.'

Figure 6. The Effect of Stock Return Uncertainty on Likelihood of IPO



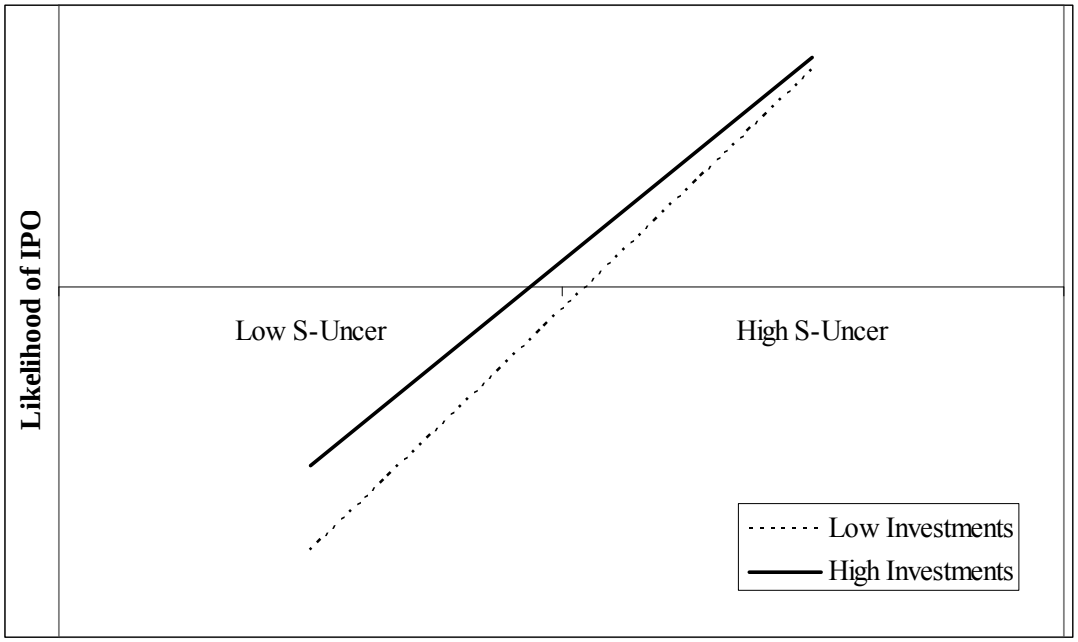
Note: This baseline model with S-Uncer depicts the influence of stock return uncertainty at two levels of uncertainty (10th percentile and 90th percentile) on the cumulative function of IPO likelihood across time under the assumption that all other covariates are zero. Stock return uncertainty at the 10th percentile is labeled as 'Low S-Uncer' and stock return uncertainty at the 90th percentile is labeled as 'High S-Uncer.'

Figure 7. Moderating Effects of VC Involvement on Product Demand Uncertainty and Likelihood of IPO



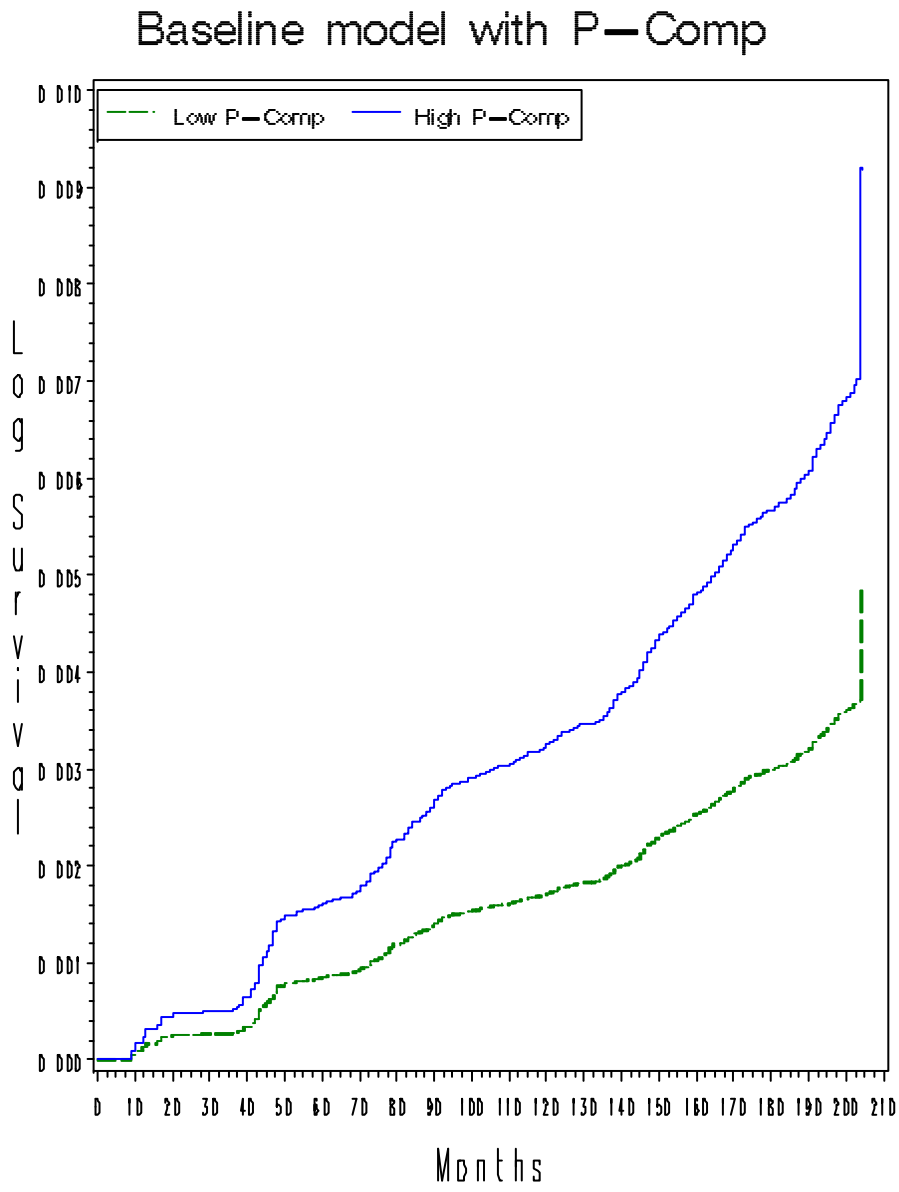
Note: The effect of the amount of venture capital investment received as a moderating variable on the effect of product demand uncertainty on the likelihood of IPO was produced by using estimates from Model 6 (Table 20). The horizontal axis represents the level of product demand uncertainty, and the vertical axis represents the likelihood of IPO.

Figure 8. Moderating Effects of VC Involvement on Stock Return Uncertainty and Likelihood of IPO



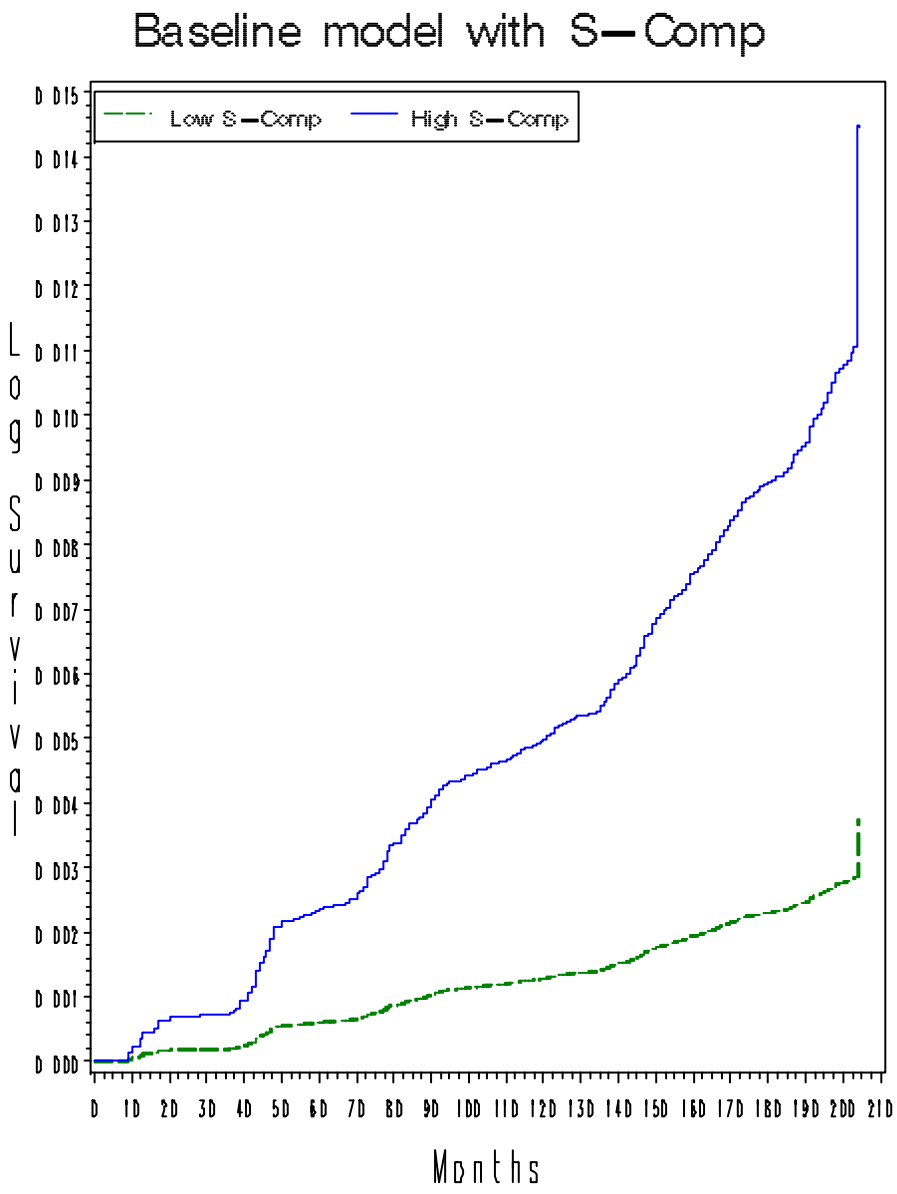
Note: The effect of the amount of venture capital investment received as a moderating variable on the effect of stock return uncertainty on the likelihood of IPO was produced by using estimates from Model 7 (Table 20). The horizontal axis represents the level of stock return uncertainty, and the vertical axis represents the likelihood of IPO.

Figure 9. The Effect of Product Market Competition on Likelihood of IPO



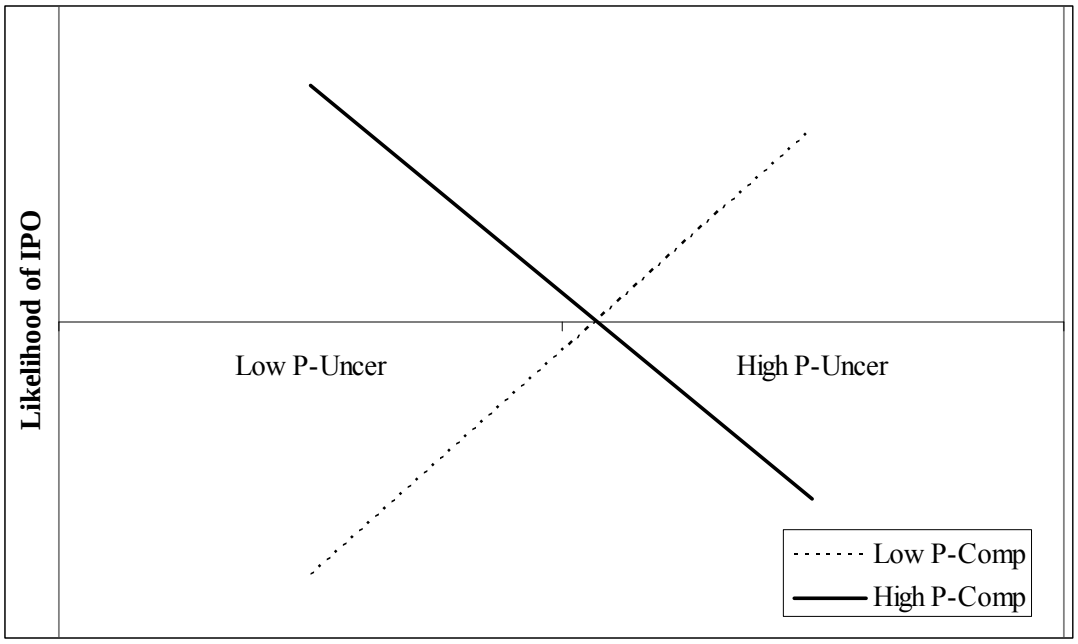
Note: This baseline model with P-Comp depicts the influence of product market competition (or the Blau Index) at two levels of competition (10th percentile and 90th percentile of the Blau Index) on the cumulative function of IPO likelihood across time under the assumption that all other covariates are zero. Product market competition at the 10th percentile is described as 'Low P-Comp' and product market competition at the 90th percentile is described as 'High P-Comp.'

Figure 10. The Effect of Competition in the IPO Offerings Market on Likelihood of IPO



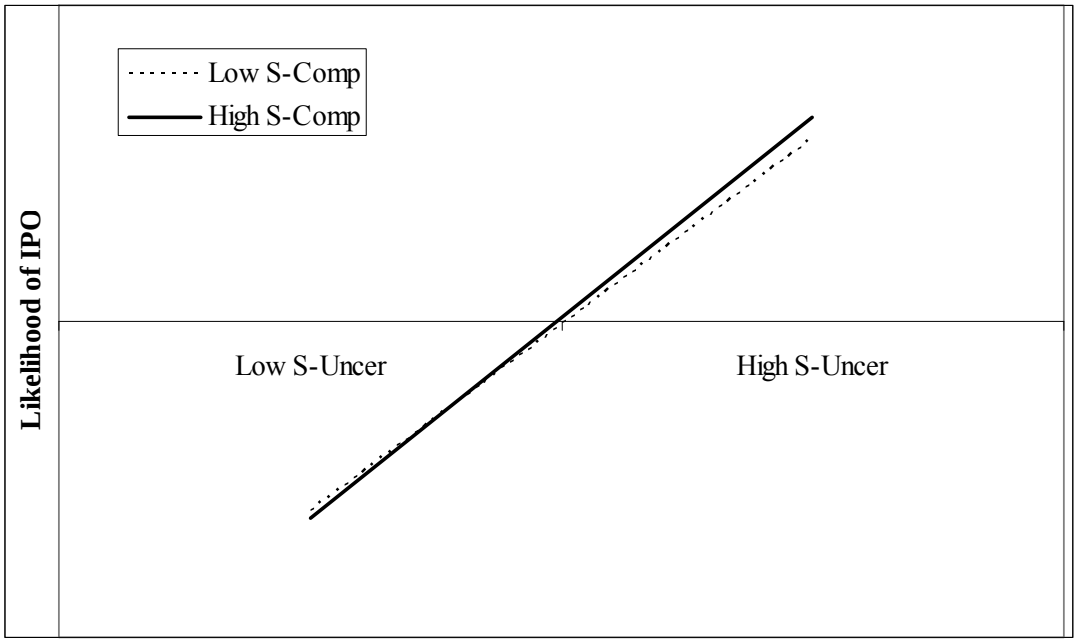
Note: This baseline model with S-Comp depicts the influence of competition in the IPO offerings market (or the number of IPO launches at any given 12-month period) at two levels of competition (10th percentile and 90th percentile) on the cumulative function of IPO likelihood across time under the assumption that all other covariates are zero. Competition in the IPO offerings market at the 10th percentile is described as 'Low S-Comp' and competition in the IPO offerings market at the 90th percentile is described as 'High S-Comp.'

Figure 11. Moderating Effects of Competition on Uncertainty and Likelihood of IPO (Product Market)



Note: The effect of competition in the product market as a moderating variable at high levels of competition and low levels of competition was produced by using estimates from Model 11 (Table 21). The horizontal axis represents the level of product demand uncertainty, and the vertical axis represents the likelihood of IPO.

Figure 12. Moderating Effects of Competition on Uncertainty and Likelihood of IPO (IPO Offerings Market)



Note: The effect of competition in the IPO offerings market as a moderating variable at high levels of competition and low levels of competition was produced by using estimates from Model 12 (Table 21). The horizontal axis represents the level of stock return uncertainty, and the vertical axis represents the likelihood of IPO.

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