SOCIAL CAPITAL OF YOUNG TECHNOLOGY FIRMS AND THEIR IPO VALUES: 
THE COMPLEMENTARY ROLE OF RELEVANT ABSORPTIVE CAPACITY

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Abstract

The strategic importance of Business-to-Business (B2B) relationships is well recognized, but their financial impact remains equivocal. This study links social capital from three types of B2B networks of young technology firms with their Initial Public Offering (IPO) value. The authors identify three relevant types of absorptive capacity that facilitate the transformation of B2B social capital into IPO value. For the transformation to occur, the authors find that young firms need not only the opportunity to access the resources provided by B2B relationships, but also the ability to leverage them through the complementary capability, namely, absorptive capacity. The hypotheses are tested on a sample of 177 IPOs and the results are robust to endogeneity concerns and alternative measures. As one of the first studies in marketing-finance interface to focus on young firms, the findings provide novel insights such as the deleterious financial consequence of having marketing and R&D B2B relationships without the relevant absorptive capacity. Managerial implications regarding communicating the value of absorptive capacity, disclosure of marketing related information, and the importance of marketing for young technology firms are also provided.

Keywords: B2B relationships, social capital, absorptive capacity, stochastic frontier estimation, IPO value, Marketing-Finance interface
The conceptual literature has recognized that Business-to-Business (B2B) relationships are valuable market-based intangible assets, which constitute social capital that can be transformed into financial value (e.g., Srivastava, Shervani, and Fahey 1998; Van den Bulte and Wuyts 2007). Prior empirical studies, however, provide conflicting evidence on the role of B2B relationships. Some suggest that these external relationships are a valuable source of resources and thus enhance firm survival and performance (Tuli, Bharadwaj and Kohli 2010; Swaminathan and Moorman 2009; Kalaignmentam, Shankar and Varadarajan 2007). On the other hand, others find that such ties do not always translate into high performance (De Wulf, Odekerken-Schröder, and Iacobucci 2001, Gulati and Higgins 2003; Guo, Lev and Zhou 2005). These mixed findings suggest that it might not be the mere presence or absence of B2B relationships that are critical, but that the phenomenon is more complex calling for further study.

Technology startups are an appropriate context to study the value of B2B relationships. B2B relationships can be of particular importance to young technology firms and their firm value for several reasons. First, such firms typically do not have the internal resources and capabilities and organizational slack of established firms and thus rely on external B2B relationships for access to critical resources and knowledge (e.g., Stuart 1998, Uzzi 1999). Second, investors are likely to seek indirect signals to assess young firms since these firms have short observable histories and limited performance records (e.g., Dekinder and Kohli 2008; Stuart, Hoang, and Hybels 1999). Previous literature has acknowledged that B2B relationships can not only signal the legitimacy of new ventures but also help develop corporate reputations (e.g., Florin, Lubatkin and Schulze 2003). Finally, investors’ uncertainty about future prospects is especially high for startups in high technology industries (e.g., Aldrich and Fiol 1994). B2B relationships can help

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1 We use the terms startups and young firms interchangeably. While this might be debatable in some circumstance, it seems appropriate for this study since the average of the firms in our sample is 7.7 years on the day of the Initial Public Offering (IPO).
young technology firms track dynamic environmental changes and boost innovation speed, product adoption, and firm growth (e.g., Rindfleisch and Moorman 2001), and thus lower investors' uncertainty in evaluating the firms’ value potential.

Against this backdrop, this study explores the conditions where B2B relationships increase startups' shareholder value. We conduct this research in a unique financial context, the Initial Public Offering (IPO) market, in which a firm seeks public equity investment for the first time. IPO is a crucial event and most important corporate financing and strategic development decision for a startup firm. While IPO research has proliferated in finance and accounting, marketing scholars have not paid much attention to this area, though marketing strategies can play an important role in a young firm’s performance (Luo 2008, DeKinder and Kohli 2008). Moreover, IPO value provides a systematic forward-looking evaluation of young firms’ future performance, which is ideal for this research context, since startup firm value depends highly on the expected future performance and growth opportunities, while historical financial performance measures, such as sales or profitability, are often zero or negative for young firms.

Our findings suggest that mere access to social capital in certain B2B networks does not necessarily benefit a young firm’s IPO market capitalization. However, young firms with strong absorptive capacity are better able to leverage the social capital accessible to enhance their IPO values. This study thus helps startup managers develop a better understanding of how to realize firm value in the stock market by wisely deploying limited resources. Specifically, they will understand why certain B2B relationships may or may not pay off, as well as the complementary capabilities required for each type of relationships to maximize their value potential. In addition, we provide evidence that marketing efforts help not only build up social capital but also realize its financial value. This finding helps senior marketing managers (such as CMOs) better
communicate marketing’s value. The study also provides managers with guidelines for their disclosure strategy.

The study makes two other important contributions. First, it contributes to the emerging contingency perspective on the marketing-finance interface, which attempts to identify and demonstrate the conditions under which marketing activities and assets are associated with stock market outcomes (e.g., Bharadwaj, Tuli and Bonfrer 2011). Second, this stream of literature almost exclusively focuses on large established firms and has for the most part ignored startup firms. Startups are a critical component of the US economy serving as sources of job creation and higher productivity and productivity gains than established firms (Kauffman Foundation Report 2008). There are significant differences in the management and valuation of young firms compared to mature firms (e.g., Sheth and Sisodia 2001). Thus the findings from research on mature firms may not apply to startups. Our findings provide unique insights not only to technology entrepreneurs and managers but also to new venture investors.

In the rest of the paper, we first review two streams of literature and highlight our theoretical contributions. We then develop the conceptual framework and specify hypotheses, relying on both established theory and five in-depth interviews with domain experts with investment banking experience. Data, methods, and empirical results will then be presented, followed by a discussion of the results, and implications for research and practice.

Prior Research

**B2B Relationships**: Previous research provides mixed results about the influence of B2B relationships on firm performance. Some strategic alliance research shows that forming alliances increases alliance participants’ stock market performance (e.g., Chan et al 1997; Das, Sen, and Sengupta 1998; Kalaignanam, Shankar and Varadarajan 2007; Swaminathan and Moorman
In contrast, other studies find that alliances have a value-reducing effect (Guo, Lev, and Zhou 2005), or have no significant impact on firm value (Gulati and Higgins 2003). Among the studies focusing on customer relationships, some suggest relational constructs such as relationship quality and satisfaction positively influence the seller’s sales, profit, and share of wallet (e.g., Morgan and Hunt 1994; Tuli, Bharadwaj and Kohli 2010), while other researchers show no significant impact (e.g., De Wulf, Odekerken-Schröder, and Iacobucci 2001, Gruen, Summers, and Acito 2000). Palmatier and colleagues (2006) conclude in their review that the mixed findings imply that the effect of B2B relationships on firm performance may be contingent on other non-modeled factors.

**Absorptive Capacity:** Cohen and Levinthal (1990) introduced the concept of absorptive capacity as a firm’s ability to identify, assimilate, and exploit external knowledge. Research on absorptive capacity has proliferated since then, as the construct provides a unique viewpoint and can be applied to many research areas (Lane, Koka, and Pathak 2006). Absorptive capacity has been associated with both intra and inter-organizational learning, and is recognized as playing a key role in B2B relationship performance (e.g., Lane and Lubatkin 1998). Scholars have unveiled the importance of absorbing implicit or tacit knowledge, i.e., *know-how* in addition to the simple *know-what* (e.g., Simonin 1999, Narasimhan, Rajiv, and Dutta 2006). However, extant studies have almost exclusively focused on R&D (Lane et al 2006) and largely ignored the learning and knowledge absorption that commonly exist in other contexts.

In this study, we incorporate these two streams of literature in addition to marketing strategy, finance, and social network research and draw on interviews with investment bankers to investigate the financial impact of *social capital* from different types of B2B relationships as well as the moderating role of absorptive capacity in the context of young firms at IPO.
work departs from and extends existing research in at least four ways. First, it enriches the B2B literature by demonstrating the contingent value of various types of B2B relationships, thus resolving the conflict in the extant findings about B2B relationships' impact on firm performance. Second, previous absorptive capacity research merely considers R&D or technological know-how. We introduce and measure marketing know-how and customer know-how absorptive capacities to match specific types of B2B relationships. Third, sociology studies argue that social capital can contribute to financial capital, but only limited empirical testing of this expectation has been attempted. We provide real-world evidence for B2B network capital's financial value. More importantly, we demonstrate that while B2B relationships provide access to resources (i.e., opportunity), firms require absorptive capacity (i.e., ability to leverage the resources) to deliver financial value, and thus contribute to the marketing-finance interface literature. Finally, our focus on startups also adds unique insights to the entrepreneurship literature.

**Conceptual Framework**

Social capital is “the aggregate of the actual or potential resources linked to possession of a durable network of more or less institutionalized relationships” (Bourdieu 1985, p. 248). It consists of: (1) the relationship itself providing access to resources possessed by the associates; and (2) the nature and amount of those resources (Portes 1998). We capture the nature of the resources by classifying startups’ B2B relationships into three types: R&D alliance relationships, marketing alliance relationships, and key customer relationships. In the social network literature, a node with higher centrality has access to more resources from the other nodes (Tsai and Ghoshal 1998). We thus employ the local (ego) centrality, i.e., the number of ties a firm has in each type of its B2B networks, to capture the amount of resources (e.g., Scott 2000).
To determine the financial outcome, IPO value, we follow the logic of Srivastava et al (1998) by analyzing the level (cash inflows, outflows), timing, and volatility of a young technology firm's future cash flows. Table 1 summarizes the potential impact of three types of B2B relationships. Figure 1 is an overview of the conceptual framework.

[Table 1 and Figure 1 About Here]

**The Impact of R&D Alliance Relationships on IPO Value**

*Positive impact.* R&D alliances involve R&D and innovating activities. Technological innovations have become more and more complex and require extensive resources (e.g., Sorescu and Spanjol 2003). Social capital from R&D alliances is a critical source of resources for a young technology firm’s R&D activities, which in turn influence its cash flows. First, R&D alliances help enhance the level of future cash flows by reducing the cash outflows. Due to great operational risks, startups typically face high financing costs, e.g., high interest on debt (e.g., Uzzi 1999). R&D alliance partners often provide financial resources and thus lower the financing cost for a young firm’s R&D activities. For example, a startup Inktomi Corp obtained $2 million funding from Intel under their R&D alliance agreement. R&D alliance partners may also provide established R&D resources (e.g., laboratories and equipment), and thus reduce the startup’s own R&D expenditures. Moreover, such alliances are likely to reduce the young firm’s R&D costs through economies of scale and scope (e.g., Gomes-Casseres 1997).

Second, R&D alliances help accelerate the speed of cash flows. Rich resources (including knowledge and information) brought by R&D alliance partners enable timely response to critical information (Lane & Lubatkin 1998), and help identify technological advancements and opportunities more quickly. R&D partners also bring about rapid prototyping, which shortens the NPD cycle and speeds up cash flows (Thomke 1998).
Third, R&D alliances help reduce the volatility of cash flows. Innovation is widely recognized as highly risky (e.g., Sorescu and Spanjol 2008). Pooled technological and financial resources in R&D alliances put young firms in a better position in a jointly-developed and well-funded laboratory with many experienced scientists to lower the risks inherent in innovation processes (Deeds and Hill 1999). R&D alliances' impact on the risk of future cash flows was also echoed by the investment bankers we interviewed, who suggested that while R&D partnerships are expected for established firms, for young firms they are critical as they serve as a stamp of approval. As one articulated, (the presence of R&D alliances) "shows that you are a company that can operate at that level...and lowers business risk, which should enhance the multiple an investor would pay for the business."

As a young firm's number of R&D alliance relationships (or R&D alliance network centrality) increases, it is exposed to more R&D resources (Tsai and Ghoshal 1998). Richer resources enhance all three effects—reduction in cash outflows and cash flow volatilities, and acceleration of cash flows—increasing the NPV of cash flows and finally the IPO value.

**Negative impact.** Joining R&D alliances may decrease startups' financial value. First, financially constrained firms, such as startups, have lower negotiating power and tend to give up too much of their ownership when entering alliances. This is called the "risk of equity relinquishment" (Aghion and Tirole 1994; Guo, Lev, and Zhou 2005). R&D alliance partners may make use of their resource advantage to behave opportunistically at the expense of the young firms. Young firms are thus not likely to obtain fair gains from the value created in the alliance. This view was echoed by the investment bankers we interviewed, exemplified by the following statement, "If the partner can extract all the value out of the relationship... partnerships can be a detractor of value."
R&D alliance relationships also run the risk of leakage of strategically important knowledge to competitors, especially if the opportunistic partner has or builds ties with the startup’s competitors (Dutta and Weiss 1997). Such partners may also play-off one partner against the other (i.e., the divide et impera principle) and thus appropriate gains from the relationship (Van den Bulte and Wuyts 2007). This in turn can reduce the level of cash flows and increase the volatility and vulnerability of cash flows.

Research finds that a nearly half of R&D alliances underperform (Park and Ungson 2003). One explanation is the tendency of alliance partners to reject external knowledge, a tendency labeled as the “not invented here” (NIH) syndrome (Katz and Allen 1982). This syndrome may have a pernicious effect on the adoption speed of external knowledge from the alliance partner, and thus eventually negatively impact the speed of cash flows of the firm.

To sum up, joining R&D alliance relationships can have both positive and negative influence on IPO value — the overall effect is unclear.

*The Moderating Role of R&D Absorptive Capacity*

To effectively transform social capital into financial value, a firm needs to actively deploy the B2B resources and convert them to a desired end. The resource based view contends that, a firm should develop relevant capability to identify and utilize resources such as external knowledge (e.g., Bharadwaj, Varadarajan, and Fahy 1993). Past research has referred to this capability as *absorptive capacity* (Cohen and Levinthal 1990). Following Narasimhan, Rajiv, and Dutta (2006), we conceptualize absorptive capacity as *the efficiency of a firm to absorb external know-how, compared with what it could have absorbed given the relevant resources it can access*. We view it as a complementary capability, but go beyond the traditional notion (Milgrom and Roberts 1995) by noting that absorptive capacity not only enhances the (positive) benefit of,
but also mitigates the negative effects of these B2B relationships. This view is consistent with the growing sentiment that isolated resources or capabilities, however valuable, may not be effective as single assets for strategic activities (Moorman and Slotegraaf 1999). Rather, the value of these assets arises from complementarities, or the manner in which they interact to impact performance. We label the efficiency of absorbing technological and R&D know-how as R&D absorptive capacity. Notably, R&D absorptive capacity coincides with the traditional conceptualization of absorptive capacity, which takes an R&D focus.

Strong R&D absorptive capacity facilitates inter-organizational learning and enables a firm to recognize and synthesize external knowledge. The learning effects enhance the economies of scale and synergies in R&D alliances (e.g., Sampson 2007), which further increase a startup’s R&D cost efficiency (further reducing cash outflows) and decrease its risk of R&D failure (further increasing the predictability of the future cash flows). Reduction in R&D failures or iterations also further shortens the NPD cycle (further accelerates cash flows).

In B2B networks, knowledge is embedded in a social context, making it more unique, less imitable, and thus more likely to create strategic value (Spender 1996). Absorption of such tacit knowledge helps a firm build up its unique R&D capabilities, which are rare, imperfectly tradable, and costly to imitate. The tacitness makes it difficult for R&D alliance partners to pass on strategic information about the startup to other firms, thus limiting the potential of playing off one partner for another and lowering the vulnerability in future cash flows. More importantly, the unique R&D capabilities form the basis of competitive advantage, predicting superior future R&D performance (e.g., Bharadwaj et al 1993). This not only enhances future cash inflows for the young firm, but also potentially increases the total size of the pie (greater expected outcomes from the R&D alliance that are to be shared among the partners) and provides the startup with
greater negotiation power in equity discussions with its alliance partners, mitigating the risk of equity relinquishment.

A firm with strong R&D absorptive capacity is likely to develop common language and shared experiences with R&D alliance partners. This should enable the young firm to more readily accept external knowledge from R&D partners, thereby minimizing the negative effects of the NIH syndrome in alliances (Cohen and Levinthal 1990). As investors tend to seek indirect signals to assess startups, a firm with strong absorptive capacity can convey a positive signal to investors regarding their ability to benefit from R&D alliance relationships and alleviate investors’ concerns about the potential negative effects. We thus expect that,

**H1**: The positive (or negative) effect of a young technology firm's R&D alliance relationships on the IPO value is enhanced (or mitigated) by its R&D absorptive capacity.

**The Impact of Marketing Alliance Relationships on IPO Value**

*Positive impact.* Marketing alliances involve activities such as co-branding, joint-marketing, and sharing of distribution channels. Marketing alliance relationships can also have impact on IPO value by influencing a startup’s future cash flows. First, marketing alliance relationships help decrease cash outflows as the partners’ experienced marketing and sales forces reduce the startup’s marketing & selling expenditures, and lower the chance of failures in product introduction and promotional campaigns (Comanor 1965).

Second, marketing alliance partners’ established distribution channels facilitate market penetration (Mitchell 1989) and accelerate cash flows. An investment banker pointed out that a key driver of *Monster Beverage*’s value is its distribution partnership with *Anheuser-Busch*. In a global market context, marketing alliances enable quicker penetration of a bigger portion of the world markets simultaneously. For instance, an alliance with *AskNet* expands the software startup *InterVideo*’s European market presence.
Third, marketing alliances can decrease the volatility of cash flows, since the partners’ established supply chains enhance channel coordination and promote stability in operations. In addition, marketing alliances entail access to the partners’ existing relationships with customers or retailers (Swaminathan and Moorman 2009). For instance, Kana Communications was allowed access to the user base of its partner NISUS; similarly, BottomLine gained access to PeopleSoft’s customers upon alliance formation. Access to loyal customer bases is valuable since revenues from such customers are less susceptible to competition (Tuli, Bharadwaj, and Kohli 2010).

*Negative impact.* Despite the above-mentioned three benefits, marketing alliances also expose young firms to greater risks of equity relinquishment. Most marketing alliance partners are established firms and are very likely to seek ownership of the products. Due to the financial constraints, young firms may concede too much of the ownership when joining marketing alliances (Aghion and Tirole 1994). Here, a disproportionate share of the value created is appropriated by the established alliance partners rather than the young firms themselves, therefore negatively influencing investors’ assessment of the young firms’ value. The situation can be worsened by the danger of dependence (Miles, Preece, and Baetz 1999), when young technology firms over-rely on their partners’ marketing capabilities. For such firms, one can expect limited future growth potential, delayed development of their own marketing capabilities, and increased uncertainty in their future marketing success after marketing alliances terminate (thus decreasing the expected level and speed of future cash-flows, and increasing the expected volatility of future cash flows). This viewpoint was echoed by one of the investment bankers who pointed out that, “Development of a unique marketing capability obviously has more value
for a company than if it is dependent on someone else to market their offerings alone. Hence, marketing alliance relationships can also lower IPO value.

**The Moderating Role of Marketing Absorptive Capacity**

Previous literature discusses absorptive capacity almost exclusively in terms of absorbing R&D or technological know-how. We conceptualize the efficiency with which a firm absorbs *marketing* know-how, relative to what it could have absorbed given the marketing resources it deploys, as *marketing absorptive capacity*.

A young firm with strong marketing absorptive capacity is more likely to grow marketing knowledge and enhance its own marketing capabilities through the transfer of knowledge in its alliance network. With their own marketing capabilities developed, a firm is less likely to over-rely on its partners' brands, channels, and marketing support and be subject to the "danger of dependence" (which influences level, speed, and volatility of cash flows as mentioned before).

As an investment banker concluded, "Having your own marketing capability typically means you can capture more economics of a transaction." It should be noted that capabilities built on tacit knowledge are unique and less imitable. They lead to competitive advantage and promote future marketing success, predicting higher and less volatile cash inflows. Moreover, a young firm with strong marketing absorptive capacity may create more value out of the alliance cooperation, and thus, holding share of the value constant, the alliance partner may get a larger amount of benefit.

This ability may provide the young firm with a better bargaining position and reduce its likelihood of conceding a disproportionate share of equity to the alliance partner. In sum, absorptive capacity facilitates the development of marketing capabilities, alleviates the danger of dependence, and minimizes the potential risk of equity relinquishment. Formally,

*H2: The positive (or negative) effect of a young technology firm's marketing alliance relationships on the IPO value is enhanced (or mitigated) by its marketing absorptive capacity.*
The Impact of Key Customer Relationships on IPO Value

Positive impact. Key customers relationships are a firm’s relationships with its business customers that contribute a significant portion of its sales. Social capital from key customer relationships helps decrease cash outflows as the growing mutual understanding, trust and solidarity in key customer relationships reduce transaction costs such as cost of contracting (e.g., Ganesan 1994). Firms with more key customer relationships are also likely to have more effective inventory and distribution management \(^2\) than firms with high customer turnover (e.g., Kalwani and Narayandas 1995). This lead to reduction in inventory and distribution costs and thus lower cash outflows.

Key customer relationships also help accelerate cash flows. The solidarity and trust in these relationships tend to provide early access to private information on customer needs (Tuli, Bharadwaj and Kohli 2010). This enables the young firm to quickly detect and react to the changes in customer needs, thus reducing the NPD cycle. Key customer relationships also enable a richer understanding of the customers’ operational and political environment, which increases the likelihood and speed of customer adoption (Tuli, Kohli and Bharadwaj 2007).

Young firms’ cash flow volatilities can also be lowered when they possess key customer relationships. These customers may provide smoother revenue streams (e.g., Tuli, Bharadwaj and Kohli 2010) and thus more stable cash flows. In addition, as a firm gains experience working with a customer, its better understanding of customer needs reduces the risks of being rejected for unsuitable offerings. Moreover, as a young firm gets familiar with key customer’s demand patterns, it can anticipate and make appropriate adjustments to its manufacturing cycle (Kalwani and Narayandas 1995). This capability to adjust production cycles can reduce the instances of

\(^2\) While our arguments on inventory / distribution costs hold for most young technology firms including those in the computer industry, they may not be as relevant to the software industry.
high customer order demand coinciding with low firm inventory levels and vice-versa (Bharadwaj et al. 2007), thus decreasing the variability of inventory costs. In line with the logic of key customer relationships—reducing the variance of cash flows, an investment banker opined that if a startup has an established relationship with a customer, țiyou should apply a lower discount rate to these cash flows given that there is more certainty.î

**Negative impact.** Developing key customer relationships often requires substantial relationship-specific investments that may have little or no value outside the relationship (e.g., Heide and John 1990). This can limit the supplier firm’s resources available to service other customers or explore other markets, thus placing constraint on the firm’s sales growth or cash inflows. For example, Miles and Snow (1992) suggest that the focus on servicing a small number of customers could make a supplier less competitive in other markets. Similarly, others find that a tight coupling with customers could restrict the vision of the firm and hurt their competitiveness in the long-run (Danneels 2003).

The speed of converting sales revenue into cash flows can also be slowed down by key customer relationships, since many young firms do not want to risk their relationships with key customers by imposing severe late-payment penalties (e.g., Summers and Wilson 2003).

Since key customers contribute a significant proportion of a firm’s sales, the risks of credit concentration might raise investors’ concerns of the firm’s ability to collect future cash inflows (e.g., Pike and Cheng 2001). Also, significant customers can pose a threat to a startup’s survival and stability of its cash flows if they ever switch. As an investment banker observed, țiRelationship with customers are important, particularly if you have any customer concentration, which can act as a red flag to the investors that you are susceptible to losing a big chunk of your business or that they have negotiating power over you when it is time to renegotiate price, etc.î
In sum, the impact of key customer relationships on IPO value turns out inconclusive, with both the positive effects and negative effects considered.

**The Moderating Role of Key-Customer Absorptive Capacity**

*Key-customer absorptive capacity* refers to the efficiency with which a firm absorbs know-how about its key customers, relative to what it could have absorbed given the key customer relationship resources it accesses. Strong absorptive capacity enhances the supplier firm’s understanding of customer needs and thus enables the firm to develop products that provide a better fit than its competitors (Hoch and Deighton 1989). This facilitates the development of the young firm’s competitive advantage, and increases customers’ dependence on the firm, resulting in the customers’ willingness to purchase a broader array of products, which in turn increases the relationship scope and sales (Kalwani and Narayandas 1995). Hence, the impact of key customer relationships on the level of cash inflows is further enhanced as absorptive capacity increases. Key-customer absorptive capacity also enhances the effect of learning and relation-specific economies of scale (Johnson and Selnes 2004), which reduce unit costs and thus further lower the level of cash outflows.

As customers’ dependence on the supplier firm increases, they have a higher motivation to maintain the on-going relationships. This could mitigate the risk of customer switching (thus decreasing the volatility of future cash flows) and help reduce accounts receivables (thus accelerating the speed of converting sales revenue into cash flows and minimizing credit risks). The growing mutual dependence between the firm and its key customers can enable access to more private information, which helps the supplier firm make more effective manufacturing adjustments that lead to even lower variance in the cost of goods sold. Better and deeper
customer knowledge brought by strong absorptive capacity also further enhances product development speed and customer adoption rate, thus speeding up cash flows.

In sum, absorptive capacity reinforces the positive effects and minimizes the negative effects of key customer relationships on the level, speed, and volatility of cash flows. Therefore,

**H3**: The positive (or negative) effect of a young technology firm’s key customer relationships on the IPO value is enhanced (or mitigated) by its key-customer absorptive capacity.

**Data**

We combined several secondary data sources in this study. We obtained a list of first-time-IPO firms in the computer industry (SIC 357) and the software industry (SIC 7371 and 7372) from 1996 through 2006 from Thomson Financial Global New Issue Database excluding those whose IPO prospectuses could not be located. Then we searched for and confirmed pre-IPO information about alliance type, alliance partners, and key customers for each company from SDC Platinum, IPO prospectus, Securities and Exchange Commission (SEC) 10-K filings, and FACTIVA. We utilized the databases of National Bureau of Economic Research (NBER) and United States Patent and Trademark Office (USPTO) for patent, patent citation, and trademark data. We collected IPO value, venture capital involvement, upper echelon information as well as accounting data, from multiple sources: IPO prospectus, Thomson Financial, CRSP, COMPU-STAT, and SEC 10-K filings. We found the number of Selling & Marketing employees from the "Employees" sections in IPO prospectuses and SEC 10-K filings. We obtained a final sample of 177 IPO firms, including 70 firms in the computer industry and 107 firms in the software industry, with an average age-at-IPO of 7.7 years. In addition to these IPO firms, we obtained information from Standard & Poor’s NetAdvantage on 116 private companies in the computer and software sector that were founded in the same period as our sample but did not offer an IPO.
Measures

Dependent Variable \( \text{IPO Value (IPOV)} \): We employ four alternate measures for IPO Value. First, following Guo, Lev, and Zhou (2005), we calculated the initial offer value by multiplying the initial offer price (midpoint of the expected offer price range established by the underwriters filed with SEC) with the expected number of shares outstanding after IPO. Second, we obtained from the front page of IPO prospectus the total price to public, i.e. the product of price per share and number of shares to be offered. Third, since the finance literature points to the common phenomena of under-pricing in IPO, we employ the firm’s market value at the end of the first trading day and at the end of the 90th day after IPO (calculated by multiplying the closing price with the number of shares outstanding on the relevant day) for robustness checks.

\( R&D \text{ Alliance Relationships (RAR)} \): is a count of a young firm’s partners in the active R&D alliances it participated in before its IPO date, i.e., we use the absolute local centrality measure (the number of links incident upon an actor) to capture the amount of social capital, the same as the ego degree centrality in an ego network of R&D alliance relationships with the young technology firm as the ego (e.g., Everett and Borgatti 2005, Freeman 1982).

\( Marketing \text{ Alliance Relationships (MAR)} \): is a count of a firm’s unique partners in the active alliances involving marketing activities (including co-branding alliances, joint-marketing alliances, channel-sharing alliances, product-integration alliances, etc.) the firm participated in before its IPO date.

\( Key \text{ Customer Relationships (KCR)} \): is a count of significant customers\(^3\), from which a firm has generated revenues for two consecutive years or longer and which were not reported as terminated in the IPO prospectus.

\(^3\) Companies report “major customers” or “customer concentration” (e.g., individual customers that contribute to 10% or higher of the firm’s annual revenues in the past years) in their IPO prospectus and statements of income.
**Absorptive Capacity**: Absorptive capacity is the efficiency of absorbing know-how, given the amount of resources available. The production frontier model in economics (e.g., Silberberg 1990) states that the maximal amount of know-how absorbable for firm $i$ can be written as a function of the resources the firm accesses (Narasimhan, Rajiv, and Dutta 2006):

\[(M-1) \quad y_{M_i} = f(\mathbf{X}_i; \text{Resources}_i, \mathbf{\bar{U}})\]

, where $y_{M_i}$ is the maximal amount of know-how absorbable, $\mathbf{X}$ is a vector of resource inputs, and $\mathbf{\bar{U}}$ is a vector of parameters for the resources.

Based on the literature, we classify the factors that influence the maximal amount of know-how absorbable (i.e., $\mathbf{X}$ variables) into three categories, namely, internal resources, external resources, and market conditions. Specific variables in each category can vary for different types of know-how absorbable (we present the detailed model specification for each type of know-how below).

However, firms often cannot reach the maximal level in the frontier. One reason is the random shocks, such as luck and other random factors out of a firm’s control. The other reason is the inefficiency of a firm in absorbing know-how.

Putting it formally, the actual amount of know-how a firm $i$ actually absorbs is:

\[(M-2) \quad y_{A_i} = f(\mathbf{X}_i; \text{Resources}_i, \mathbf{\bar{U}}) x \exp(\mathbf{\bar{U}}) x \exp(- \mathbf{\eta}_i)\]

, where $y_{A_i}$ is the actual amount of know-how absorbed, $\mathbf{\bar{U}}$ is the random shock, and $\mathbf{\eta}_i$ captures the inefficiency of absorbing know-how, $\mathbf{\eta}_i \geq 0$.

Since absorptive capacity is the *efficiency* of absorbing know-how, we can derive absorptive capacity measures based on the estimation of the inefficiency term $\mathbf{\eta}_i$.

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Companies also report the termination of major selling contracts or customer relationships in their SEC filings. We also searched the companies around their IPO dates in FACTIVA to check news about termination of customer relations. We include only active and current relationships as only these are likely to impact future cash flows and the impact of terminated relationships have already been fully reflected in financial outcomes, e.g., cash flows from operations, ROA, etc. which are controlled for in the model.
\textit{R&D Absorptive Capacity (RD\textunderscore AC)}: Taking natural logarithm on both sides of (M-2), for firm \( i \) in each year \( t \) (\( t = 1, \dot{\ldots}, T_i \)) during the past \( T_i \) fiscal years before IPO,

\begin{equation}
\ln(\text{RDKA}_{it}) = \ln(\text{M} - 3) + \ln(\text{RD}_{\text{KA}it}) = \alpha_0 + \alpha_1 \ln(\text{XRD}_{it}) + \alpha_2 \ln(\text{INVS}_{it}) + \alpha_3 \ln(\text{RAR}_{it}) + \alpha_4 \ln(\text{INV}_{Sit}) + \alpha_5 \ln(\text{MC}_i) + \alpha_6 \ln(\text{RD}_{\text{KA}it-1}) + \epsilon_{it} - \eta_{it},
\end{equation}

where, \( \text{RDKA}_{it} \) = R&D Know-how Absorbed (following Narasimhan, Rajiv, and Dutta 2006, RDKA is measured as the number of patent classes drawn by a firm that do not overlap with the firm’s original domain of expertise, i.e., the collection of total classes of patents it owns) by firm \( i \) in year \( t \);

\( \text{XRD}_{it} \) = R&D expenditure of firm \( i \) in year \( t \);

\( \text{INVS}_{it} \) = innovation stock (citation-weighted patent count) of firm \( i \) in year \( t \);

\( \text{RAR}_{it} \) = count of R&D alliance partners of firm \( i \) in year \( t \); and

\( \text{MC}_i \) = market conditions (dummy variables based on the four-digit SIC code of firm \( i \)).

The \( X \) variables on the right-hand-side (RHS) of Equation M-3 capture the three aforementioned categories of factors that influence the maximal amount of R&D know-how absorbable. Specifically, according to Cohen and Levinthal (1990), firms with the two types of internal resources, R&D expenditures\(^4\) and technological expertise (measured by innovation stock), should be able to absorb more R&D know-how. We use the count of R&D alliance partners to capture the external R&D resources accessible (Deeds and Hill 1999). In addition, we include dummy variables to control for industry/market conditions (Narasimhan, Rajiv, and Dutta 2006). Since existing economics studies suggest the importance of lagged dependent variable in explaining R&D productivity (e.g., Hall, Griliches, and Hausman 1986), we include lagged RDKA on the RHS to account for the possible momentum in absorbing R&D know-how.

Assuming that \( \epsilon_{it} \sim N(0, \sigma_{\epsilon}^2) \), \( \eta_{it} \sim N(\mu, \sigma_{\eta}^2) \) with \( \epsilon > 0 \), \( E[\epsilon_{it}, \eta_{it}] = 0 \), and that the two error components are independently distributed of the independent variables in Equation M-3, we now follow Narasimhan, Rajiv, and Dutta (2006) and estimate R&D absorptive capacity using stochastic frontier method (SFE). The maximum likelihood estimates (MLE) of the parameters \( \epsilon, \mu \) and \( \sigma \) (mean of \( q \), standard variance of \( \tilde{q} \) and \( q \)) are first derived following Battese and

\(^4\) We include R&D expenditures from both the corresponding year and the previous year on the RHS, since literature indicates the common existence of time-lag between R&D expenditures and patent outcomes (e.g., Blundell, Griffith, & Windmeijer 2003). We thank an anonymous JM reviewer for pointing this out.
Coelli (1992). Consistent estimate for the inefficiency term \( \eta_i \) can then be obtained from the mean of the conditional distribution \( f(\eta|\xi) \). Finally, we rescale the estimation of \( \eta_i \) to be between 0 and 100 and measure R&D absorptive capacity as 100 - \( \eta_i \) (the higher the inefficiency, the lower the absorptive capacity).

**Marketing Absorptive Capacity (MK_AC):** We use the same input-output model structure as specified in Equation M-3 to estimate a firm’s (in)efficiency in absorbing marketing know-how. Analogous to the R&D know-how measure, we capture the amount of marketing know-how absorbed by counting the classes of the trademarks filed by a firm that do not overlap with the firm’s area of expertise (measured by the classes of registered trademarks the firm owns).

Consistent with the specification in the R&D frontier, the internal resources consist of not only selling & marketing expenditures, but also marketing expertise (measured by trademark class stock), since a large body of absorptive capacity literature suggests that prior related knowledge plays an important role in absorbing new knowledge (e.g., Lane et al 2006). We use the number of marketing alliance partners to capture the external resources accessible, and industry dummy variables to capture market conditions. Consistent with the R&D SFE in Equation M-3, the lagged output is included on the RHS to capture the possible momentum in know-how absorption. For firm \( i \) in year \( t \),

\[
\ln(MKKA_{it}) = \bar{\gamma} + \bar{\beta} \ln(XSM_{it}) + \bar{\beta} \ln(XSM_{it-1}) + \bar{\beta} \ln(TMCS_{it}) + \bar{\beta} \ln(MAR_{it}) + \bar{\beta} \ln(MC_{it}) + \bar{\beta} \ln(MKKA_{it-1}) + \bar{\eta} + \bar{\epsilon}_{it} - \eta_{it},
\]

\[
E(\eta_{it}|\xi_{it}) = \frac{M_i + D_i \{\phi(1 - M_i/D_i) / [1 - \phi^{-1}(1 - M_i/D_i)]\}}{\phi^{-1}(1 - M_i/D_i)}, \text{ where } M_i = (\epsilon \bar{\gamma} - \bar{\beta} \sum_{t=1}^{T} \xi_{it} \bar{\gamma}^2) / (\bar{\gamma} + \bar{\beta} \sum_{t=1}^{T} \bar{\gamma}^2), \text{ and } D_i = (\bar{\gamma} + \bar{\beta} \sum_{t=1}^{T} \bar{\gamma}^2). \]

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5. \( \bar{\gamma} = \ln(RDKA_{it}) - \left[ \bar{\beta} \ln(XSM_{it}) + \bar{\beta} \ln(XSM_{it-1}) + \bar{\beta} \ln(TMCS_{it}) + \bar{\beta} \ln(MAR_{it}) + \bar{\beta} \ln(MC_{it}) + \bar{\beta} \ln(RDKA_{it-1}) \right] \); \( E(\eta|\xi) = \frac{M_i + D_i \{\phi(1 - M_i/D_i) / [1 - \phi^{-1}(1 - M_i/D_i)]\}}{\phi^{-1}(1 - M_i/D_i)}, \text{ where } M_i = (\epsilon \bar{\gamma} - \bar{\beta} \sum_{t=1}^{T} \xi_{it} \bar{\gamma}^2) / (\bar{\gamma} + \bar{\beta} \sum_{t=1}^{T} \bar{\gamma}^2), \text{ and } D_i = (\bar{\gamma} + \bar{\beta} \sum_{t=1}^{T} \bar{\gamma}^2). \)
Then $q^*$ is estimated and rescaled following the same approach as above and marketing absorptive capacity can be measured as $100-q^*$.

**Key-Customer Absorptive Capacity (KC_{AC}):** The know-how absorption process does not only include the identification and acquisition of know-how, but also applying the acquired know-how to commercial end (Cohen and Levinthal 1990). The operationalizations of the outputs in the R&D know-how SFE (Equation M-3) and marketing know-how SFE (Equation M-4) reflected this logic, using new patent classes and new trademark classes, respectively, to capture the desired commercial outcomes. Since revenue generation is the major goal of customer relationship management, we employed the sales revenue generated from the key customers to reflect the amount of know-how absorbed (identified, acquired, and utilized) from the key customers. For firm $i$ in year $t$ with $K_i$ key customers $k$ ($k = 1, 2, \ldots, K_i$),

\[
\ln(\sum_{k=1}^{K_i} REV_{i,k,t}) = \tilde{\beta}_0 + \tilde{\beta}_1 \ln(SMEMP_{it}) + \tilde{\beta}_2 \ln(REC_{i,t}) + \tilde{\beta}_3 \ln(PATS_{it}) + \tilde{\beta}_4 \ln(K_i) + \tilde{\beta}_5 MC_i + \tilde{\beta}_6 \ln(\sum_{k=1}^{K_i} REV_{i,k,t-1}) + \tilde{\gamma}_i q_i + \epsilon_{it} - \eta_{it},
\]

where $REV_{i,k,t} =$ firm $i$'s sales revenue generated from customer $k$ in year $t$; $SMEMP_{it} =$ firm $i$'s number of selling and marketing employees; $REC_{i,t} =$ firm $i$'s account receivables to customer $k$ in year $t$; $PATS_{it} =$ patent stock (count of the patents owned) of firm $i$ in year $t$; and $MC_i =$ market conditions (dummy variables based on the four-digit SIC code of firm $i$).

We include three variables to represent the internal resources: selling & marketing employees, account receivables, and technology stock. As highlighted by the relationship marketing literature, interpersonal relations play a vital role in B2B selling (e.g., Abdul-Muhmin 2005). We thus include selling & marketing employees as an important internal resource. This also avoids the risk of double-counting selling & marketing expenditures (already included in M-4). We expect that accounts receivables can enhance sales to key customers since they can be viewed as a firm's investment in the customer relationship (interest-free loans to customers) (e.g., Dutta, Narasimhan, and Rajiv 1999). Dutta et al. (1999) also suggest that technology stock can be another important internal resource that increases sales, since it helps convince the key customers...
about the firm’s technological advantage and better retain the customers with updated new products. We use the number of key customers to capture the level of external resources, and industry dummies to control for market conditions. Consistent with Equations M-3 and M-4, a lagged dependent variable is added to the RHS to control for the potential momentum effect.

After $\eta_i*$ is estimated and rescaled following the aforementioned approach, key-customer absorptive capacity can be measured as $100 - \eta_i*$.

Control Variables $(Q)$: First, finance and management studies have demonstrated that venture capital involvement signals issue quality and leads to favorable valuation of a firm, thus influencing IPO performance (e.g., Ritter and Welch 2002). Therefore, we control for the effect of VC investment in the firm. Second, underwriter reputation has also been considered by the finance literature as a signal of new issue quality. We adopted the Carter-Manaster underwriter ranking to control for this effect (e.g., Carter and Manaster 1990). Third, we control for the experience of upper echelons, i.e., top managers and directors (e.g., Cohen and Dean 2005). The upper echelon experience is measured by the average managerial and board positions a firm's upper echelons had prior to joining the current firm. Fourth, IPO markets may fluctuate with macroeconomic cycles and dynamics. Therefore, we include IPO year dummies to control for the financial market conditions at the time a firm goes IPO. We also use an industry dummy (0 to computer and 1 to software) to control for the industry effect. Finally, we control for firm age at IPO and accounting information, including cash flows from operations, return on asset, R&D expenditures, and selling and marketing expenditures of the last fiscal year before IPO.

**Model & Estimation Procedure**

The basic regression equation (including the interaction effects) explaining the IPO Value of firm $i$ is:
(1) \[ \ln(\text{IPO}_i) = \beta_0 + \beta_1 \times \ln(\text{RAR}_i) + \beta_2 \times \ln(\text{MAR}_i) + \beta_3 \times \ln(\text{KCR}_i) + \beta_4 \times \text{RD}_i + \beta_5 \times \text{MK}_i + \beta_6 \times \text{CA}_i + \beta_7 \times \ln(\text{RAR}_i) \times \text{RD}_i + \beta_8 \times \ln(\text{MAR}_i) \times \text{MK}_i + \beta_9 \times \ln(\text{KCR}_i) \times \text{KCR}_i + \beta Q \times Q_i + e_i \]

However, firms self-select whether to go public or stay private (e.g., Pagano et al 1998), and IPO value is only observable for firms that do go public. Following Shaver (1998), we control for the self-selection bias with the two-stage estimation approach suggested by Heckman (1979). A firm's choice to go public (i.e., IPO value is observed, or IPO_i = 1) can be explained as a function of firm attributes and industry conditions, i.e.,

(2) \[ \text{IPO}_i^* = \gamma W_i + u_i, \text{ and } \text{IPO}_i = 1 \text{ if } \text{IPO}_i^* > 0 \]

Following Ritter and Welch (2002), Pagano et al (1998), and Gulati and Higgins (2003), we include the number of employees (to reflect firm size), revenue, geographical location, industry, and year of foundation in the \( W_i \) vector to explain the likelihood of going IPO. We then compute the inverse Mills Ratio \( \varphi = \hat{\varphi}(\gamma W_i) / \Phi(\gamma W_i) \) derived from the probit specification in Equation 2 (\( \hat{\varphi} \) and \( \Phi \) are, respectively, the probability density function and cumulative density function of normal distribution), and add it to the RHS of Equation 1 to control for the selection bias and derive unbiased estimates of \( \beta \).

**Results**

Table 2 provides the descriptive statistics and the correlation matrix of the variables in the Heckman second-stage model. Although the difference between the initial offer value and total price to public indicates that original shareholders typically retain a large proportion of shares outstanding upon IPO (e.g., Busaba, Benveniste, and Guo 2001), these two measures are highly correlated (0.81). In line with the convention of IPO studies (Guo, Lev, and Zhou 2005), we scale the values by total assets to address skewness and control for heteroscedasticity, since

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6 The B2B network centrality variables used in the main model are different from those in the SFE equations (M-3, M-4, and M-5). In the SFE models, these variables are used as longitudinal data recorded for each fiscal year prior to IPO over time. In the main model, these variables are the counts of relationship partners at one time point before IPO. So this operation is not likely to cause multicollinearity or "double-counting" issue. We conducted robustness check by excluding the B2B relationship variables from SFEs and the results remain robust.
other possible deflators such as sales, book value of equity, or earnings often take negative or zero values for young firms. R&D absorptive capacity, marketing absorptive capacity, and key-customer absorptive capacity are derived from stochastic frontier estimations as specified.

Table 3 reports the estimates of $\beta$ in Equation 1 after controlling for the potential self-selection bias. In the main-effect model (Model 1), the estimated coefficients of R&D and marketing alliance relationships are not significant. This suggests that social capital from alliance networks may not directly lead to high IPO value. However, the coefficient of key customer relationships is positive and significant ($\beta_3 = .53, p < .01$). Hence, despite the potential dark side, key customer relationships can be very beneficial to young firms' market capitalization.

Model 2 includes the moderating effects of absorptive capacity hypothesized in H1, H2, and H3. The model fit is significantly enhanced after including the three interaction factors ($R^2$ increases from 45.38% to 48.42%, F-test of the change in $R^2$: $F(3, 148) = 2.91, p < .05$). In support of H1, the estimated interaction effect between R&D alliance relationships and R&D absorptive capacity is positive and significant ($\beta_7 = 1.19, p < .05$). The moderating effect of marketing absorptive capacity on marketing alliance relationships is also positive and significant ($\beta_8 = .09, p < .05$), supporting H2. These indicate that young firms need strong absorptive capacity to transform the social capital from R&D and marketing alliance relationships into IPO value. However, although the interaction between key customer relationships and absorptive capacity exhibits a positive coefficient, the impact is not significant on firms' initial offer values.

Employing the Johnson-Neyman technique (see Hayes & Matthes 2009), we plotted the three interaction effects in Figure 2. The technique allows us to identify the statistical significance of the impact of each type of B2B relationships on IPO value at a given level of absorptive capacity. As shown in Figure 2-1 and Figure 2-2, R&D and marketing alliance
relationships can enhance IPO value for firms with high levels of relevant absorptive capacity (one standard error above the mean). In contrast, if firms have low absorptive capacity (one standard error below the mean), the impact is negative and significant. This means that R&D and marketing alliance relationships can potentially harm IPO value if firms lack absorptive capacity. We provided the rationale of this negative impact, as well as how absorptive capacity moderates this impact, in Table 1. According to Figure 2-3, key customer relationships appear to significantly benefit young firms’ market capitalization, and the positive effect holds (although the statistical significance decreases) even for firms with relatively low absorptive capacity.

Consistent with the finance literature (e.g., Barry et al 1990), we find support for the positive impact of venture capital involvement and underwriter ranking. The coefficient of the inverse Mills Ratio $\varphi$ is not significant. The positive coefficients of the year 1999 and 2000 dummies might be attributable to the Dot-com bubble peaking around 1999 to 2000.

**Robustness Check**

Although our model and hypotheses were based on good theoretical pedigree, we employed alternative measures and alternative model to confirm the robustness of our results. **Alternative Measures:** First, we reran the model with alternative IPO value measures, namely, total price to public, market value at the end of first trading day and the 90th day after IPO, respectively, as the dependent variable. The results are reported in the first three columns of Table 4. Second, we replaced the absolute degree centrality with weighted (by the size of B2B relationship partners$^7$) centrality to address the concern that partners of different sizes may contribute asymmetric amount of social capital. The results (reported in the fourth column in

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$^7$ Weighted-B2B-Relationships$^7$ = $\frac{\sum_{j=1}^{I} \text{Weight}_{i,j} \cdot X_{i,j}}{\sum_{i=1}^{I} \left( \sum_{j=1}^{J} \text{Weight}_{i,j} \cdot X_{i,j} \right)}$, where $i = 1, 2, \ldots, I$, and $I = 177$ is the number of sample firms; $j = 1, 2, \ldots, J$, and $J_i^*$ is the number of firm $i$’s B2B (R&D alliance, marketing alliance, or key customer relationship) partners; Weight$_{i,j}$ is the R&D expenditure of firm $i$’s R&D alliance partner $j$, or the selling and marketing expenditure of firm $i$’s Marketing alliance partner $j$, or the percentage of firm $i$’s sale to its key customer $j$ per the firm’s total sale.
Table 4) are consistent with Table 3. Third, we re-estimated marketing know-how absorptive capacity with sales revenue (instead of new trademark classes) as the output variable in SFE. Accordingly, the input variables include current and lagged marketing & selling expenditures and number of trademarks (internal resources), number of marketing alliance partners (external resources), market conditions, and lagged sales revenue. The coefficients of the model using this estimate are reported in the fifth column of Table 4. Fourth, since the momentum of generating patents has not always been considered in previous literature (e.g., Narasimhan, Rajiv, and Dutta 2006), we rerun the R&D SFE by excluding the lagged R&D know-how absorbed. The results (sixth column of Table 4) using the new estimates of R&D absorptive capacity remain consistent. Fifth, we include three lags (t-1, t-2, and t-3) of R&D / marketing and selling expenditures in Equation M-3 / M-4 and re-estimate R&D / marketing absorptive capacities. Results using these alternative estimates are reported in the seventh column of Table 4.

Overall, the results are robust across different measures of the key constructs.

Alternative Selection Model: Firms may self-select to form B2B relationships, and better firms can be more likely to attract B2B partners. To control for this potential self-selection bias, we first conducted a probit regression\(^8\) to explain the likelihood for sample firms to form B2B relationships. We then added the inverse Mills ratio derived from this selection model in Equation 2 and reran the analysis (the lambda derived from the IPO-selection equation was no longer included since the error terms of the two selection equations can be correlated). The results are reported in the last column of Table 4, and are consistent with those in Table 3.

\(^8\) Following Stuart (1998) and Villalonga & McGahan (2005), we included sales (to control for firm size), R&D expenditures (R&D resources), selling & marketing expenditures (marketing resources), number of patents (technological base), number of trademarks (stock of marketing assets), ROA (current general accounting performance), and industry dummy to predict the likelihood of forming B2B relationships. The dependent variable in the probit regression equals one if the firm has formed at least one pre-IPO B2B relationship. We employed robust variance estimator to correct for heteroscedasticity. Inverse Mills ratio is calculated in the same way as in the approach to control for IPO-decision self-selection bias.
Additional Analysis: – Determinants of Young Technology Firms’ Absorptive Capacity

We have estimated absorptive capacity with SFEs and observed significant heterogeneity in absorptive capacity across firms. We now conduct additional analysis to explain this heterogeneity. Existing research on the determinants of absorptive capacity almost exclusively focuses on mature firms, and thus examines the impact of factors such as organizational structures (e.g., Cohen and Levinthal 1990) and functional capabilities (e.g., Narasimhan, Rajiv, and Dutta 2006). However, for most startups, organizational structures or functional capabilities have yet to be developed (and that is why they are in a more urgent need to absorb know-how from outside). Therefore, we focus on the upper echelon structure to explain startups’ absorptive capacity (top management executives and board of directors), since upper echelons play a major role in deploying startups’ resources (e.g., Kor 2003).

If a young firm has a diversified upper echelon team (e.g., each executive or director served a different organization prior to joining the current firm), it is likely to have a variety of perspectives to examine potential resources, and thus enjoy an advantage in identifying external know-how. Diversity in background may also predict weaker social ties among upper echelons, compared with upper echelons with very similar background (e.g., a group of former IBM employees started their own business). The social network literature argues that weak-ties are efficient for sharing new knowledge because they facilitate access to novel information (Granovetter 1973). In contrast, strong ties may constrain the inflow of new knowledge by handicapping the search process. Thus, upper echelon diversity can positively influence the efficiency in absorbing know-how (given the maximal amount of know-how available).

On the other hand, the level of common language and the strength of expertise in overlapped domains decrease as the diversity in upper echelon increases. This can reduce the
efficiency in communicating and applying the external know-how identified, and thus harm absorptive capacity. Moreover, communication within a diversified upper echelon team may suffer from *biased information sampling*, where in-common information rather than novel information is shared (Shiflett 1979). Taken together, the theoretical arguments of upper echelon diversity on absorptive capacity appear equivocal, calling for an empirical resolution.

We follow Narasimhan, Rajiv, and Dutta (2006) and specify the empirical model as $\ln(\varepsilon_i) = \xi^* + Z \hat{\gamma} + \epsilon_i \bar{\mu}$. Since $\xi$ captures inefficiency in absorbing know-how, we expect a $Z$ variable that enhances absorptive capacity to have a *negative* coefficient (i.e., it reduces the inefficiency). In addition to examining upper echelon diversity, we also control for the other characteristics of the upper echelons. The list of $Z$ variables and their coefficients is available in the Web Appendix (Table A-2). The results suggest that a diversified upper echelon team generally benefits a startup firm’s absorptive capacity. For example, the diversity in the experience of R&D executives (e.g., Vice President of Research and Development, Chief Technology Officer) decreases the inefficiency in absorbing R&D know-how ($-0.263, p < .1$) and thus enhances R&D absorptive capacity. The diversity in the background of a firm’s upper echelons decreases the inefficiency in absorbing marketing know-how ($-0.072, p < .1$) and thus enhances marketing absorptive capacity. Moreover, the upper echelons’ strength in a particular functional area is significantly associated with the matching type of absorptive capacity. For example, firms with more R&D executives in the upper echelon are likely to have stronger R&D absorptive capacity.

The number of upper echelons with marketing background (i.e., those that held marketing and

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$^9$ $\varepsilon_i$ (consistent estimate $M_i$ has been derived as in Footnote 5) is the mode of inefficiency term $\varepsilon_i$. $Z$ represents the independent variables including upper echelon factors (note that the $Z$ variables here explain the inefficiency in absorbing know-how, while the three categories of $X$ variables in Equation M-1 explain the maximal amount of know-how absorbable), $\hat{\gamma}$ is the vector of coefficients, $\hat{\epsilon} \bar{\mu}$ is a standard normal variable, $\bar{\mu}^2$ is the variance in $\varepsilon$ due to unobservable effects. Diversity is measured by the proportion of the number of unique organizations that all upper echelon members (or all R&D or marketing and sales executives) had served relative to the sum of the number of organizations that each upper echelon member (or each R&D or marketing and sales executive) had served prior to joining the current firm. Estimates of $\hat{\gamma}$ can then be derived from maximum likelihood estimation.
sales positions prior to joining the current firm) and the number of marketing and sales executives are positively associated with marketing and customer absorptive capacities, respectively.

**Discussion**

**Theoretical Contribution**

A systematic review of prior literature indicates that B2B relationships can both benefit firm performance and pose potential risks, and the overall effect might be contingent. We examine the financial value of three types of B2B social capital, conditional on a complementary capability, the relevant type of absorptive capacity, in the context of young IPO firms.

The study enriches the marketing strategy literature by demonstrating the role of relevant absorptive capacity in B2B relationship management. In the process, it is one of the first studies to link absorptive capacity with B2B social capital and firm value. In contrast to previous absorptive capacity research that focuses primarily on R&D know-how, we expand this concept and unveil its importance in marketing alliance and customer relationships. Though extant research has recognized that customer relationships may pose mixed effects on firm performance (e.g., Danneels 2003), few studies have explicitly investigated the financial value of customers. We fill in this research gap by demonstrating the impact of key customers on IPO value. We also contribute to the customer relationship management literature by highlighting the role of absorptive capacity in realizing key customer relationships’ financial potential.

We add to the literature that has attempted to link young firms’ interfirm networks with their financial performance. Uzzi (1999) investigates the impact of relationship embeddedness on startup borrowing (interest rates on loans). In comparison, we focus on another significant financing event, the IPO, and examine the factors that help increase the value potential of B2B
relationships. Our study also resolves a conundrum that prior research in management has faced. Gulati and Higgins (2003) find that, despite the significant investments involved, the number of a firm's strategic alliances does not have significant impact on its IPO success. In contrast, we find that, although the main effects of R&D and marketing alliance relationships are not significant, their interactions with relevant absorptive capacity significantly enhance IPO value. Our study thus provides empirical evidence to sociology theories on the financial potential of social capital. More importantly, we reveal the conditions under which such potential can be best realized.

This study also makes distinctive contributions to the marketing-finance interface literature. First, we show that marketing efforts do pay off since they both (1) help build up valuable B2B social capital (e.g., the significant main effect of KCRs), and (2) enhance the financial benefits of such social capital (e.g., the significant moderating effects of marketing absorptive capacity). Second, this study is among the first to investigate the financial impact of marketing resources and capabilities in the IPO market. This unique perspective provides insights into marketing strategy and financial performance of startup firms, which have rarely been studied in the extant marketing-finance literature. Third, the study adds to the emerging contingency perspective in the marketing-finance interface by demonstrating that complementary assets such as absorptive capacities are required to benefit from B2B relationships.

**Managerial Implications**

*Communicating the Value of Absorptive Capacity.* As shown in Figure 2, investors are likely to respond negatively when a young firm lacks the ability to leverage R&D and marketing alliance relationships. On the other hand, firms that have strong absorptive capacity can financially benefit from these B2B relationships, since they can understand, evaluate, and assimilate the relevant external resources and capabilities from their partners. These complementary and
supplementary gains to their existing capabilities are valued by the market as they are likely to enable young firms in designing superior value propositions for their market into the future. Startups, therefore, first need to be cognizant of the impact of these factors and develop their absorptive capacity. For instance, our additional analysis indicates that young firms may be able to enhance absorptive capacity by recruiting executives or directors with backgrounds that are different from the current upper echelon team. Moreover, managers in a firm possessing strong absorptive capacity need to articulate the benefits of this capability in meetings with analysts in order to convince investors of the importance of B2B relationships for the firm. In support, an investment manager suggested that firms must trumpet this ability along with highlighting the relationships during the road shows prior to IPO. He argued that this better informs investors and one or two things may happen … (1) investors will qualitatively be more excited about the company’s prospects which leads to bigger book (more demand for the stock) being built which will lead to the offering being priced at the high point of the range or (2) investors assess a lower discount rate to future projections which pumps up value.

Going Beyond Statutory Disclosure of Customer Relationships. Accounting standards (FASB Statements 14 and 131) require the reporting of customers who contribute 10% or more of a firm’s revenues, since it makes the firm vulnerable to customer switching and therefore more risky. However, the pioneering finding in this study of the positive impact of key customer relationships suggests that, unlike R&D relationships, the mere existence of key customer relationships creates IPO value. Thus it pays off for young firms to invest in key customer relationships to enhance firm value. However, while the results do not necessarily indicate that key customer relationships are more important than other types of B2B relationships, it appears that the investment community finds it relatively easier to assign values to key customer
relationships, as the outcomes (e.g., sales revenue generated from key customers) are directly observable. Moreover, young firms with adequate levels of customer related absorptive capacity are not only more sensitive to business opportunities in the customer firm, but are perhaps more proactive in exploiting them. Taken together, the implication for managers is that they should go beyond statutory disclosure to capitalizing on the disclosure. Managers could communicate to institutional and individual investors that despite the risk of credit concentration, key customers yield cash flow benefits that lead to greater firm value.

**Role of Marketing in Young Technology Firms.** Marketing usually plays a secondary role in young technology firms, which are typically dominated by technical personnel. However, this study suggests that these young firms would gain significantly in terms of how they are valued if they invest in marketing. For example, investing in customer management pays through the direct effect of key customer relationships, and efforts in developing marketing absorptive capacity can help augment the financial benefits of marketing alliances. Moreover, our additional analysis suggests that recruiting marketing personnel and senior managers with marketing and sales experience (as members of the upper echelon) will enhance marketing and key-customer know-how absorptive capacities. The findings suggest that CMOs and other marketing managers of startups should make a case for investments in marketing and customer management expertise and use these results to better justify to CEOs and CFOs the financial value of such investments.

**Limitations and Directions for Future Research**

Although we employ multiple methods to enhance the robustness and rigorousness of the empirical analyses, we can only test association, instead of causation. However, the IPO value measure is forward-looking, while the exogenous variables in the model are contemporaneous or
lagged. Thus the reverse direction of causation is less likely under this context. Our systematic theory construction strongly supports the direction of the relationships hypothesized and tested.

We reveal the significant role of absorptive capacity in B2B relationship management and financial market capitalization, and explored the impact of upper echelon structure on young firms’ absorptive capacity. Future research can investigate the antecedents of absorptive capacity more systematically, and generate more insights into how startups can develop absorptive capacity. In addition, future research could examine firms’ effectiveness in applying and further enhancing its previously-developed absorptive capacity in newly-formed B2B relationships.

Mizik and Jacobson (2007) show that changes in marketing spending influence stock market returns following seasonal equity offering (SEO). Marketing capabilities and B2B relationships can also be expected to impact SEO performance. Under this context, future research could explore the dynamics in the valuation process, i.e., how the value of startups changes when they acquire new resources and capabilities. Future studies can also develop richer measures of B2B social capital. In addition to network structures, strength of ties can be examined. It is even more important to understand how to manage social capital and realize its value potential, than merely look at the nature of B2B network resources. A comparative study of the firm value drivers for startups and those for established firms would also be meaningful.
References


Granovetter, Mark (1973) "The Strength of Weak Ties", *American Journal of Sociology*, 78 (6), 1360-80.


Van den Bulte, Christophe, Stefan Wuyts (2007), *Social networks and marketing*. MSI.

Table 1: Impact of B2B Relationships on Young Technology Firms’ IPO Value

<table>
<thead>
<tr>
<th>Effects on the Level of Cash Flows</th>
<th>Positive Impact on IPO Value (increase the level of cash flows)</th>
<th>Negative Impact on IPO Value (decrease the level of cash flows)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D &amp; Alliance Relationships</td>
<td>- [AC +] Reduce R&amp;D costs</td>
<td>- [AC ⟩ Increase the likelihood of equity relinquishment</td>
</tr>
<tr>
<td></td>
<td>- [AC +] Enhance R&amp;D capabilities and future cash inflows</td>
<td>- [AC ⟩ Increase the risk of leakage of strategically important knowledge to competitors</td>
</tr>
<tr>
<td>Marketing &amp; Alliance Relationships</td>
<td>- [AC +] Reduce marketing and sales costs</td>
<td>- [AC ⟩ Constrain future sales growth if young firms over-rely on partners’ marketing capabilities</td>
</tr>
<tr>
<td>Key Customer Relationships</td>
<td>- [AC +] Enhance marketing capabilities and future cash inflows</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effects on the Speed of Cash Flows</th>
<th>Positive Impact on IPO Value (increase the speed of cash flows)</th>
<th>Negative Impact on IPO Value (decrease the speed of cash flows)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D &amp; Alliance Relationships</td>
<td>- [AC +] Facilitate faster response to critical information (e.g., new technology development)</td>
<td>- [AC ⟩ Not invented here (NIH) syndrome may prevent speedy acceptance of external technological knowledge</td>
</tr>
<tr>
<td></td>
<td>- [AC +] Shorten NPD cycle</td>
<td></td>
</tr>
<tr>
<td>Marketing &amp; Alliance Relationships</td>
<td>- [AC +] Facilitate market penetration</td>
<td>- [AC ⟩ Deter the development of young firms’ down marketing capabilities if young firms over-rely on alliance partners’ marketing capabilities</td>
</tr>
<tr>
<td>Key Customer Relationships</td>
<td>- [AC +] Penetrate a bigger proportion of the world markets in a speedy manner</td>
<td>- [AC +] Reduce the speed of converting sales revenue into cash flows, as firms do not want to risk their relationships with key customers by imposing late-payment penalties</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effects on the Volatility of Cash Flows</th>
<th>Positive Impact on IPO Value (decrease the volatility of cash flows)</th>
<th>Negative Impact on IPO Value (increase the volatility of cash flows)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D &amp; Alliance Relationships</td>
<td>- [AC +] Reduce the risks in R&amp;D processes and the chance of R&amp;D failures with pooled resources, thus increasing the predictability and stability of future cash flows</td>
<td>- [AC +] Decrease the predictability of future cash flows due to the risk of equity relinquishment</td>
</tr>
<tr>
<td></td>
<td>- Provide positive signal to investors and reduce their perceived business risks</td>
<td>- [AC ⟩ Reduce the predictability of future cash flows as the risk of know how leakage increases</td>
</tr>
<tr>
<td></td>
<td>- Promote better channel coordination and operations stability</td>
<td>- [AC ⟩ Increase the uncertainty of long-run marketing success if the young firms over-rely on alliance partners’ marketing capabilities</td>
</tr>
<tr>
<td></td>
<td>- Access to partners’ customer base, reducing the variability in sales</td>
<td>- [AC ⟩ Increase unpredictability due to the risk of equity relinquishment</td>
</tr>
<tr>
<td></td>
<td>- [AC +] Reduce variability in future revenues and costs as young firms develop their own marketing capabilities and assets</td>
<td>- [AC ⟩ Increase the risks of credit concentration</td>
</tr>
<tr>
<td></td>
<td>- Provide smooth revenue streams</td>
<td>- [AC ⟩ Increase the vulnerability of cash inflows when key customers switch to competitors</td>
</tr>
<tr>
<td></td>
<td>- [AC +] Reduce the variance in transaction costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- [AC +] Reduce the chance of being rejected for unsuitable offerings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- [AC +] Reduce the variance in inventory costs (may not be as relevant to firms in the software industry)</td>
<td></td>
</tr>
</tbody>
</table>

Note: [AC +/–] means the particular impact can be enhanced/mitigated by relevant absorptive capacity (logics are explained in the main text).
Table 2
Descriptive Statistics and Correlation Matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>S.D.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
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<td>Initial Offer Value</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Price to Public</td>
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<td>137.19</td>
<td></td>
<td></td>
<td>.81</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D Alliance Rltns</td>
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<td>2.12</td>
<td>-.05</td>
<td>-.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mkting Alliance Rltns</td>
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<td>2.02</td>
<td>.07</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<td>Key Customer Rltns</td>
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<td>.02</td>
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<td>.00</td>
<td>.05</td>
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<td></td>
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<td>11.75</td>
<td>61.02</td>
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<td></td>
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<td>Mkting Expenditures</td>
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<td>Assets</td>
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<td>.52</td>
<td>.58</td>
<td>.06</td>
<td>.11</td>
<td>.12</td>
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<td>.67</td>
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<tr>
<td>Venture Capital Investment</td>
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<td>.06</td>
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<td>.60</td>
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<td>ROA</td>
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<td>.08</td>
<td>.06</td>
<td>-.08</td>
<td>.05</td>
<td>.04</td>
<td>-.06</td>
<td>.19</td>
<td>.16</td>
<td>-.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Cashflow from Operations</td>
<td>3.94</td>
<td>43.85</td>
<td>.53</td>
<td>.52</td>
<td>-.11</td>
<td>.04</td>
<td>.17</td>
<td>-.35</td>
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<td>.44</td>
<td>.33</td>
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<td></td>
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<tr>
<td>Underwriter Ranking</td>
<td>7.61</td>
<td>2.48</td>
<td>.11</td>
<td>.13</td>
<td>.03</td>
<td>.01</td>
<td>.04</td>
<td>.07</td>
<td>.07</td>
<td>.02</td>
<td>.21</td>
<td>-.12</td>
<td>-.01</td>
<td></td>
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</tr>
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<td>Upper Echelon Experience</td>
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<td>1.38</td>
<td>.04</td>
<td>.04</td>
<td>.02</td>
<td>.05</td>
<td>.13</td>
<td>.19</td>
<td>.10</td>
<td>-.05</td>
<td>.29</td>
<td>-.12</td>
<td>.00</td>
<td>.21</td>
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<td></td>
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<tr>
<td>R&amp;D Absorptive Capacity</td>
<td>28.11</td>
<td>29.64</td>
<td>-.08</td>
<td>-.09</td>
<td>.02</td>
<td>.08</td>
<td>.03</td>
<td>-.14</td>
<td>-.22</td>
<td>-.13</td>
<td>-.02</td>
<td>-.18</td>
<td>-.15</td>
<td>.06</td>
<td>.02</td>
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<td>Mkting Absorptive Capacity</td>
<td>42.62</td>
<td>29.36</td>
<td>-.01</td>
<td>.12</td>
<td>-.02</td>
<td>.03</td>
<td>.03</td>
<td>-.00</td>
<td>.05</td>
<td>.11</td>
<td>.08</td>
<td>-.02</td>
<td>.07</td>
<td>-.09</td>
<td>-.14</td>
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<tr>
<td>Key Cus. Absorptive Capacity</td>
<td>56.12</td>
<td>26.67</td>
<td>.19</td>
<td>.33</td>
<td>.00</td>
<td>.12</td>
<td>-.06</td>
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<td>.13</td>
<td>.21</td>
<td>-.02</td>
<td>-.08</td>
<td>.09</td>
<td>.11</td>
</tr>
</tbody>
</table>

- Variables 1, 2, 6, 7, 8, 9, and 11 are in millions of USD.
- Correlations that are statistically significant at 5% level are presented in bold.
- R&D absorptive capacity, marketing absorptive capacity, and key-customer absorptive capacity are derived from Stochastic Frontier Estimations.
- The value of variables reported in this table is the original value. Variables 1 to 7, 9, and 11 will be scaled by Assets (variable 8) when used in model estimations.
Table 3
The Effects of Three Types of B2B Relationships, Three Types of Absorptive Capacity, and Their Interactions on IPO Value

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Heckman 2-Stage Model 1</th>
<th>Heckman 2-Stage Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D Alliance Relationships (RAR)</td>
<td>-.40</td>
<td>-.41</td>
</tr>
<tr>
<td>Marketing Alliance Relationships (MAR)</td>
<td>.30</td>
<td>.05</td>
</tr>
<tr>
<td>Key Customer Relationships (KCR)</td>
<td>.53***</td>
<td>.60***</td>
</tr>
<tr>
<td>R&amp;D Absorptive Capacity (RD_AC)</td>
<td>.06*</td>
<td>.05*</td>
</tr>
<tr>
<td>Marketing Absorptive Capacity (MK_AC)</td>
<td>.03*</td>
<td>.06*</td>
</tr>
<tr>
<td>Key-Customer Absorptive Capacity (KC_AC)</td>
<td>.09</td>
<td>.11</td>
</tr>
<tr>
<td>RAR x RD_AC</td>
<td>H1 (+)</td>
<td>1.19**</td>
</tr>
<tr>
<td>MAR x MK_AC</td>
<td>H2 (+)</td>
<td>.09**</td>
</tr>
<tr>
<td>KCR x KC_AC</td>
<td>H3 (+)</td>
<td>.03</td>
</tr>
<tr>
<td>Industry Dummy</td>
<td>-0.06</td>
<td>-0.05</td>
</tr>
<tr>
<td>Lambda (inverse Mills ratio)</td>
<td>.00</td>
<td>10</td>
</tr>
<tr>
<td>Firm Age at IPO</td>
<td>-0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>Cash Flows From Operations</td>
<td>.55*</td>
<td>.43*</td>
</tr>
<tr>
<td>Return on Assets (ROA)</td>
<td>-.58</td>
<td>-.40</td>
</tr>
<tr>
<td>R&amp;D Expenditures</td>
<td>.05</td>
<td>.13</td>
</tr>
<tr>
<td>Selling &amp; Marketing Expenditures</td>
<td>.44*</td>
<td>.43*</td>
</tr>
<tr>
<td>Venture Capital Involvement</td>
<td>.02*</td>
<td>.02*</td>
</tr>
<tr>
<td>Underwriter Ranking</td>
<td>.63**</td>
<td>.71**</td>
</tr>
<tr>
<td>Upper Echelon Experience</td>
<td>.05</td>
<td>.06</td>
</tr>
<tr>
<td>Year 1997</td>
<td>.21</td>
<td>.22</td>
</tr>
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<td>Year 1998</td>
<td>.11</td>
<td>.11</td>
</tr>
<tr>
<td>Year 1999</td>
<td>.71***</td>
<td>.72**</td>
</tr>
<tr>
<td>Year 2000</td>
<td>.45*</td>
<td>.47</td>
</tr>
<tr>
<td>Year 2001</td>
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<td>Year 2002</td>
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<td>Year 2003</td>
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<td>Year 2004</td>
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<tr>
<td>Year 2005</td>
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<td>.11</td>
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<tr>
<td>Year 2006</td>
<td>-.32</td>
<td>-.42</td>
</tr>
</tbody>
</table>

R²=45.38%  R²=48.42%

Model 1 is the main effect model, while Model 2 includes interaction effects, as specified in Equation 1.

Entries are coefficients. One, two, and three asterisks indicate the two-tailed (one-tailed for interaction terms) significance at the 10%, 5%, and 1% levels, respectively. We calculated bootstrapped standard errors to cope with the potential "estimated regressor problem" since estimated quantities (absorptive capacity variables) are used as independent variables (See Wooldridge 2002, Econometric Analysis of Cross Section and Panel Data, for more details).
Table 4: Robustness Check

<table>
<thead>
<tr>
<th>Robustness Check with Alternative Measures</th>
<th>Alternative measure for dependent variable</th>
<th>Alternative measures for independent variables</th>
<th>Robustness Check with Alternative Modeling Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total price to public</td>
<td>End-of-1st-day value</td>
<td>90th-day value</td>
</tr>
<tr>
<td>R&amp;D Alliance Relationships (RAR)</td>
<td>-.15</td>
<td>-.62</td>
<td>-1.35</td>
</tr>
<tr>
<td>Marketing Alliance Relationships (MAR)</td>
<td>.13*</td>
<td>.78</td>
<td>-.12</td>
</tr>
<tr>
<td>Key Customer Relationships (KCR)</td>
<td>.26**</td>
<td>1.42*</td>
<td>.01</td>
</tr>
<tr>
<td>R&amp;D Absorptive Capacity (RD_Ac)</td>
<td>.19***</td>
<td>.24*</td>
<td>.29*</td>
</tr>
<tr>
<td>Marketing Absorptive Capacity (MK_Ac)</td>
<td>.02</td>
<td>.11</td>
<td>.05</td>
</tr>
<tr>
<td>Key-Customer Absorptive Capacity (KC_Ac)</td>
<td>.09*</td>
<td>.01</td>
<td>.20*</td>
</tr>
<tr>
<td>RAR x RD_Ac</td>
<td>.13*</td>
<td>2.23*</td>
<td>.84*</td>
</tr>
<tr>
<td>MAR x MK_Ac</td>
<td>.10*</td>
<td>.07</td>
<td>.08</td>
</tr>
<tr>
<td>KCR x KC_Ac</td>
<td>.02</td>
<td>.42*</td>
<td>.28**</td>
</tr>
</tbody>
</table>

IPO value is measured by the initial offer value other than indicated. All models include control variables. Entries are coefficients. One, two, and three asterisks indicate the two-tailed significance (one-tailed for interaction factors) at the 10%, 5%, and 1% levels, respectively.
2-1: The Interaction Effect between R&D Alliance Relationships and R&D Absorptive Capacity (R&D AC)

2-2: The Interaction Effect between Marketing Alliance Relationships and Marketing Absorptive Capacity (Marketing AC)

2-3: The Interaction Effect between Key Customer Relationships and Key-Customer Absorptive Capacity (Key-Cus AC)
## Web Appendix

### Table A-1: Coefficients of Stochastic Frontier Estimation (SFE) Equations

<table>
<thead>
<tr>
<th>Input variable</th>
<th>Coefficient</th>
<th>Input variable</th>
<th>Coefficient</th>
<th>Input variable</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R&amp;D SFE</strong></td>
<td></td>
<td><strong>Marketing SFE</strong></td>
<td></td>
<td><strong>Key Customer SFE</strong></td>
<td></td>
</tr>
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<td>R&amp;D expenditures</td>
<td>.023</td>
<td>S&amp;M expenditures</td>
<td>.275*</td>
<td>S&amp;M employees</td>
<td>.245*</td>
</tr>
<tr>
<td>Lagged R&amp;D exp.</td>
<td>.053*</td>
<td>Lagged S&amp;M exp.</td>
<td>.478*</td>
<td>Account receivables</td>
<td>.179**</td>
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<td>Innovation stock</td>
<td>2.306***</td>
<td>Trademark class stock</td>
<td>.001</td>
<td>Patent stock</td>
<td>.079*</td>
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<td><strong>External resources</strong></td>
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</tr>
<tr>
<td>No. of R&amp;D alliance</td>
<td>.041*</td>
<td>No. of marketing alliance</td>
<td>.082*</td>
<td>No. of key customers</td>
<td>.992***</td>
</tr>
<tr>
<td>partners</td>
<td></td>
<td>partners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Market conditions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIC3571</td>
<td>.002</td>
<td>SIC3571</td>
<td>2.201**</td>
<td>SIC3571</td>
<td>1.198*</td>
</tr>
<tr>
<td>SIC3572</td>
<td>-.551</td>
<td>SIC3572</td>
<td>-1.240</td>
<td>SIC3572</td>
<td>-.080</td>
</tr>
<tr>
<td>SIC3575</td>
<td>-.023</td>
<td>SIC3575</td>
<td>1.264</td>
<td>SIC3575</td>
<td>1.029</td>
</tr>
<tr>
<td>SIC3577</td>
<td>2.844***</td>
<td>SIC3577</td>
<td>-.042</td>
<td>SIC3577</td>
<td>.186</td>
</tr>
<tr>
<td>SIC7371</td>
<td>-1.222</td>
<td>SIC7371</td>
<td>-2.200</td>
<td>SIC7371</td>
<td>.833</td>
</tr>
<tr>
<td><strong>Lagged output</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged R&amp;D know-how</td>
<td>.076</td>
<td>Lagged marketing</td>
<td>-.086</td>
<td>Lagged key customer</td>
<td>.222***</td>
</tr>
<tr>
<td>how absorbed</td>
<td></td>
<td>know-how absorbed</td>
<td></td>
<td>how absorbed</td>
<td></td>
</tr>
</tbody>
</table>

### Table A-2: Additional Analysis to Explain the Heterogeneity in Startups’ Inefficiency in Absorbing Know-how

<table>
<thead>
<tr>
<th>Diversity of R&amp;D executives' experience</th>
<th>R&amp;D know-how</th>
<th>Marketing know-how</th>
<th>Key-customer know-how</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity of marketing &amp; sales executives' experience</td>
<td>- .263*</td>
<td>.032</td>
<td>.053</td>
</tr>
<tr>
<td>Diversity of upper echelons' experience (overall)</td>
<td>.139</td>
<td>-.072*</td>
<td>-.024</td>
</tr>
<tr>
<td>Number of R&amp;D executives</td>
<td>-.199***</td>
<td>.009</td>
<td></td>
</tr>
<tr>
<td>Number of marketing &amp; sales executives</td>
<td>-.128**</td>
<td>.006</td>
<td>.032*</td>
</tr>
<tr>
<td>Number of upper echelons with R&amp;D experience</td>
<td>.175</td>
<td>.020</td>
<td>.005</td>
</tr>
<tr>
<td>Number of upper echelons with marketing &amp; sales experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alliance executive dummy</td>
<td>.000</td>
<td>-.282*</td>
<td></td>
</tr>
<tr>
<td>Firm age</td>
<td>.152*</td>
<td>-.041</td>
<td>.018</td>
</tr>
</tbody>
</table>

Note: A negative coefficient in Table A-2 means a negative impact on the inefficiency of absorbing know-how, and thus a positive impact on absorptive capacity.