

Investigating Signals on Equity Crowdfunding: Human Capital, Earlier Investors, and Social Capital

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ABSTRACT

Although crowdfunding has emerged as a promising route to fundraising success, little is known about the specifics of equity-based crowdfunding. Using a data set of 1,111 start-ups with investment funding totaling over \$4.67 billion, we analyzed the association between a start-up's underlying characteristics and its funding outcome. We found that a start-up's funding outcome is positively associated with its human capital, but negatively associated with earlier investors' business experience. Furthermore, our analyses revealed that investors have higher levels of social capital are a noise signal to later investors. These findings shed light on the critical role of human capital, investors' experience, and social capital as credible signals for start-up investment in equity crowdfunding.

Keywords: Equity Crowdfunding, Investing Signal, Human Capital, Earlier Investors, Social Capital

I . Introduction

Along with the emergence of professional social networking sites, online start-up social networking sites and crowdfunding platforms have grown steadily by attracting investors and ventures. Traditionally, geographic distance between investors and start-ups was important (Ahlers et al., 2015; Huang et al., 2013) because investors generally relied on offline or local networks when they sought out companies in which to invest. However, online start-up platforms

such as AngelList and Crunchbase have brought a paradigm shift in investing patterns by providing open databases with information about start-ups, investors, milestones, etc. (Xiang, 2012). By overcoming geographical and temporal constraints, more start-ups have more chances to raise funds from various sources; likewise, investors have gained wider selections for investment by obtaining a depth of information online.

Importantly, this effect of a long-tail phenomenon occurs not just because of the ease of access to in-

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formation, but also through the participation offered on crowdfunding platforms that connect companies, people, and products online (Hemer, 2011; Ibrahim, 2012; Salminen, 2014). According to the Massolution Report (2015), the crowdfunding market has grown 167% since 2014. North America is the largest market, and Asia surpassed Europe in 2014. Kickstarter and IndieGogo, the most well-known and popular crowdfunding platforms, provide reward-based fundraising. Although reward-based crowdfunding is probably the most common form, crowdfunding is generally classified into four types: donation-, reward-, lending-, and equity-based (Hemer, 2011). Compared with the other three crowdfunding types, equity-based crowdfunding is a relatively new concept that allows contributors to buy company shares and receive equity in return. Because it involves monetary returns, equity crowdfunding investment has been controversial and has faced various legal challenges (Mollick, 2014). Despite these controversies, equity crowdfunding has helped industries and economies by boosting investment. The U.S. Securities and Exchange Commission (SEC) approved equity crowdfunding as a legal investing activity (JOBS Act, Title II) on September 23, 2013 (Stemler, 2013).

This political support has greatly stimulated the adoption of equity crowdfunding by both investors and innovative high-tech ventures (e.g., mobile start-ups). According to Statista (2016), the number of mobile app downloads amounted to approximately 138 billion in 2014 and will increase to 268 billion in 2017. Therefore, this convergence of mobile technology and equity-based crowdfunding has offered entrepreneurs opportunities to access funding for their innovative products and services. However, few studies have been done on the success factor of innovative high-tech companies that offer equity to their backers. Instead, most of the literature on crowd-

funding has focused exclusively on the reward- and donation-based crowdfunding markets.

In this study, we identify several factors that explain the underlying mechanisms of equity crowdfunding that are related to the funding outcomes of high-tech startups. We collected data from AngelList, one of the largest global equity crowdfunding platforms, and our unique data sets allowed us to measure different start-ups' underlying success factors empirically. The objective of this study is to identify the factors associated with funding outcomes as credible signals in the context of equity crowdfunding. To achieve our objective, we addressed the following research questions: (1) How is a start-up's human capital associated with funding outcomes in equity crowdfunding? (2) How is earlier investors' experience associated with funding outcomes in equity crowdfunding? and (3) How is a start-up's social capital associated with funding outcomes in equity crowdfunding?

To better understand what kinds of underlying characteristics are related to a start-up's funding outcome, we conducted an empirical analysis using data sets that contain about 20,000 investment activities involving funding of more than \$4.67 billion. Our empirical analyses found several interesting pieces of evidence. We found that a start-up's funding outcome is positively associated with human capital, suggesting that empowering human capital can be an effective funding tool that could function as a credible signal to potential investors. This result provides a critical insight that investors should not overlook or underestimate the human capital assets of start-ups. In addition, a high level of participation in a start-up by professional investors, such as venture capitalists and angel investors, rather than experienced business investors, might be a credible signal for later investors. In terms of social capital, board members and advisors are associated with funding

outcomes, whereas investors have higher levels of social capital might be a noise signal to later investors.

This study contributes to research and practice in several ways. First, we contribute to the literature on crowdfunding, especially equity crowdfunding, by highlighting the important factors related to a start-up's funding outcome. Second, we add to the literature on signaling theory by identifying key signals for early-stage innovative high-tech start-ups in the context of equity crowdfunding. Third, we add to the literature on firms' valuation by providing new approaches to assessing a firm's underlying value based on factors related to earlier investors.

The remainder of this paper is organized as follows. First, we provide an overview of the earlier literature on crowdfunding, signaling theory, and firm valuation. Second, we present our research model and hypotheses. Third, we explain the research context and data. Then we develop our empirical analysis based on the research hypotheses. Finally, we conclude with a discussion of the key results, directions for future research, and implications for research and practice.

II. Conceptual Background

2.1. Crowdfunding

Crowdfunding comes from profit sharing and community benefit, and the crowd can support a firm without necessarily becoming a consumer (Belleflamme and McGlashan, 2014; Han, 2013). Hemer (2011) described four basic types of crowdfunding: donation-, reward-, lending-, and equity-based. Donation-based funders donate money based on charitable motivations for mostly nonprofit projects. Conversely, reward-, lending-, and equity-based crowdfunding are motivated primarily by the pursuit of a material or monetary return.

<Table 1> shows how equity crowdfunding differs from other forms of crowdfunding and from traditional funding. One of the biggest advantage of equity crowdfunding is that start-up can raise money quickly on the crowd funding platform. Traditionally, venture funding has relied on offline networks, such as founders, family, friends, angel investors, and venture capitalists. In contrast, venture funding on crowdfunding platforms relies on online networks in which

<Table 1> Characteristics of Crowdfunding and Traditional Funding

	Equity Crowdfunding	Other crowdfunding (Donation, reward, and lending based)	Traditional funding
Network tie	Online (weak)	Online (No tie or weak)	Offline
Homophily	Mixed (School, job, and experience)	Interest-based (Art, music, fashion, films...etc.)	Background-based (School and experience)
Deal flow	Through online platform	Through online platform	Networks or proactive outreach
Due diligence	Conducted by individual or online platform	Conducted by individual or online platform	Conducted by investors based on their own experience or by outside firms
Geographic proximity	Online	Online/Local	Local
ROI and motivation	Financial return is critical	Financial return is not main reason	Financial return is critical
Investment stage	Seed and early stage	-	Seed, early stage, and late stage
Example	Angellist and Gust	Kickstarter and Indiegogo	Offline groups

geographical and temporal constraints do not affect investing decisions. In both traditional and crowdfunding, homophily plays a critical role in how investment decisions are made. For example, traditional funding decisions were background-based (e.g., common school ties and experience), and general crowdfunding decisions reflect interests (e.g., art, music, fashion, films, etc.). However, equity crowdfunding decisions are typically made based on a mixture of elements (e.g., school, job, and experience).

In the same way that traditional funding favored venture capital as a source of financing, entrepreneurs have increasingly turned their attention to equity crowdfunding (Gerber et al., 2012; Ley and Weaven, 2011; Lin and Viswanathan, 2014; Makris, 2015; Voelker and McGlashan, 2013). Equity crowdfunding is the most recent iteration of crowdfunding and the most complex. According to recent studies (Bradford, 2012; Gerrit et al., 2015), equity crowdfunding could differ from other types of crowdfunding. Generally, financial return is not the primary motivation in reward crowdfunding. The startup is to offer the product as a value about what the backers have committed. For example, if a backer commits \$100 for a pre-order, the start-up will make a product after funding is complete and send it back to the backers. In contrast, in equity crowdfunding, contributors buy shares of a company and in return receive a small piece of ownership because its funders were primarily motivated by the prospect of a financial benefit. Under these circumstances, the intrinsic value of an investment increases with the business value of a company. In this regard, equity-based has the advantage of minimizing the risk of investors compared to other types. Further, the crowd-funded startup will be able to reflect crowd's ideas and listen to market needs, which is a great help for early-stage startups.

Several researchers have recently studied herding behavior in the crowdfunding market (Burtch et al., 2011). Herding behavior is “everyone doing what everyone else is doing (Banerjee, 1992),” and reputation can be measured as a herding signal (Agrawal et al., 2014). Burtch et al. (2011) have found herding behavior can negatively affect investing decisions, and it is more apparent in larger markets. Indeed, inexperienced investors are more likely to join the herd and reduce the average level of knowledge in the market. For example, online auction bidders tend to exhibit herding behavior bias toward popular items with many bidders (Dholakia et al., 2002). This implies that later bidders are influenced by earlier bidders.

More recently, Kim and Viswanathan (2016) examined the role of reputable investors in the mobile application crowdfunding market to investigate whether earlier investors serve as quality signals for later investors. According to their research, investors can benefit from the information available on an equity crowdfunding platform by using it as an investment tool. In recent years, interest in investigating crowdfunding projects and funding providers has been increasing.

However, few studies have extensively investigated funding receivers, such as start-ups and other ventures, in the equity crowdfunding market. Our study focuses on human capital, earlier investors' experience, and social capital as quality signals, and we investigated how the herding behaviors or cascade-like behaviors of crowdfunding investors are related to funding outcomes. Hence, our study adds to the growing literature on equity crowdfunding by highlighting the important factors related to a start-up's funding outcome.

2.2. Signaling Theory

Signaling theory provides a basis for understanding the role of signaling, as first explained by economist Michael Spence (1973). Spence has argued that substantial information asymmetries exist between potential employees and employers in the job market. Therefore, employers often face problems when they evaluate people to hire. According to Spence (1973), employees should transfer reputational information (e.g., education level and characteristics) to potential employers as a way to signal their ability levels. On the other hand, when potential employees vary in quality, potential employers should interpret those signals based on costs and benefits.

Extending Spence's theory, Pollock and Gulati (2007) explored the effects of multiple signals from entrepreneurial companies in the process of an initial public offering (IPO) by examining technology companies between 1995 and 2000. According to their study, multiple signals increase an early-stage company's ability to form strategic alliances related to its IPO by reducing uncertainty about its quality and future prospects. In addition, the signaling effect diminishes over time with the age of the company and the experience level of investors.

In a recent study, Kim and Viswanathan (2016) have analyzed the ex-post performance of apps, and they have found that the quality signals provided by experts' investment choices are indeed credible. To examine earlier investors as a signal, Kim and Viswanathan identified three types of investors: app developer investors, experienced investors, and crowd. They found that the crowd is more influenced by the app developer investors for concept apps and by the experienced investors for live apps. However, discussion of the role of earlier investors' credible experience and occupations as a quality signal for

a start-up remains sparse. Our study adds to the literature on signaling theory by conducting an in-depth analysis of earlier investors in the equity crowdfunding market.

2.3. Firm Valuation

Penrose (1959) has developed the "theory of the growth of the firm," which emphasizes the resource-based capability of a firm. Penrose has argued that human capital, such as managerial resources play a key role in a firm's growth. For example, higher amounts of human capital can lead to a competitive advantage for a firm by improving productivity. On the other hand, Porter (1980) has emphasized external factors, such as population density or market forces, and Teece et al. (1997) have argued that internal factors, such as capabilities, culture, and strategy, are important factors in the growth of a firm. John et al. (1994) have examined the characteristics of high net-worth individuals, regardless of their investment history or their interest in venture investing, and found that groups of investors are diversified. In addition, Shane (2000) has examined various characteristics unique to entrepreneurial firms.

One of the primary challenges faced by investors has been the lack of a reasonable valuation method (MacMillan et al., 1986). Therefore, venture capitalists and angel investors often have to expend considerable time and effort in arriving at investment decisions because start-up assets are difficult to measure. Damodaran (2009) has argued that investors should be able to manage a successful portfolio of investments to deal with high uncertainty. According to Damodaran, start-ups share some common characteristics, such as no histories, little revenue (if any), operating losses, dependence on private equity, high

failure rates, multiple claims on equity, and illiquidity. More specifically, start-ups are diverse and have no track records; therefore, valuing a start-up is vague and difficult (Van Gelderen, 2005). Damoran (2009) suggested two model valuation approaches: intrinsic (discounted cash flow) and relative (scaling values, company comparisons, proxies for risk, controls for survival, and adjustments for differences in illiquidity).

Coleman (1988) described social capital as the resources that can be derived from social relationships. Recently, Hofer and Aubert (2013) investigated the importance of perceived bridging and bonding online social capital by differentiating between followers and followees. However, the importance of earlier investor types and their influence as a form of social capital for a start-up has been severely neglected in prior studies because of a lack of data and approaches. Our study contributes to the literature on assessing a firm's valuation by considering earlier investors' experience and online social capital as one of a start-up's underlying growth factors.

Research focused on business success factors has rarely empirically examined social capital because of its ambiguous definition and data limitations. Instead of identifying the share of nonexecutive directors on a venture's board as social capital (Ahlers et al. 2015), our study measures the number of followers of a firm or investors in it because we believe that the entrepreneurs' or the investors' social skills are better measures of social capital. Furthermore, with high-tech start-ups (e.g., mobile start-ups), their valuation is important for entrepreneurs and investors because of frequent mergers and acquisitions due to their potential for high financial rewards. However, researchers have paid scant attention to innovative high-tech start-ups in the context of equity crowdfunding. The literature that does exist tends

to focus on these firms' performance factors rather than on their business success factors. Instead of studying a broad range of start-ups, our study focuses on the signaling involved with innovative tech start-ups. Therefore, our study adds to the literature on firms' valuation by identifying innovative high-tech start-ups' growth factors related to their outcomes on equity crowdfunding.

III. Hypotheses

We developed hypotheses based on the related literature in crowdfunding, signaling theory, and valuation of firms. First, we formulated hypotheses about how a start-up's characteristics, such as human capital, are associated with funding outcomes (H1a - H1b). Second, we hypothesized a potential relationship between the prior experience of earlier investors and funding outcomes (H2a and H2b). Last, by analyzing the number of followers of earlier investors (H3a - H3c), we hypothesized that the influence level of earlier investors is related to funding outcomes.

3.1. Human Capital

From the perspective of company valuation, a high level of human capital can foster a firm's growth by enhancing performance (Bosma et al., 2004; Damoran, 2009; Lee et al., 2015; Penrose, 1950). This human capital is one of the resources that can create economic value for a firm, and a high level of human capital in an innovative start-up leads to greater collective knowledge and skills. Specifically, inexperienced investors are likelier to be attracted by young ventures with a high amount of human capital (Ahlers et al., 2015). Because crowd investors are inexperienced and the start-ups are in their early

stages on the crowdfunding platform (Wilson and Testoni 2014), an innovative start-up with a high amount of human capital has the highest chance of gaining attention (Edralin, 2007).

In accordance with the definition of human capital from previous research (Lucas, 1988; Lucas, 1990), we identified the human capital of a start-up as its founders and its team members at the manager level. One of the most significant challenges in the formation of a start-up is to build a team capable of ensuring the start-ups' survival. How well a team comes together to leverage its members' abilities is crucial to the success of a start-up. Team members typically are founders or employees whose compensation is in company equity and revenue shares; thus, team members are mostly decision makers. Because the entrepreneurs who found start-ups usually receive no pay until the company generates revenue or gains investors, they seek team members who share the same goals and philosophy. Indeed, a large number of team members can signal good management and teamwork to potential investors, and this is likely also true in the context of equity crowdfunding. Therefore, we propose the following hypothesis.

H1a: The number of current members will be positively associated with funding outcomes in equity crowdfunding.

In terms of human capital, collective knowledge and skill sets can be aggregated by the number of employees. Employees may work collaboratively. Such collaborative tasks can improve product and service quality (Kittur and Kraut, 2008) through the competition of heterogeneous diverse opinions (Leimeister, 2010). In addition to the number of current team members in H1a, we identified the number of employees as the human capital of a

start-up (Lucas, 1988; Lucas, 1990). Hypothesis 2b examines whether the number of employees in the start-up is essential to the funding outcome. If positive, it can explain that having more employees can attract crowd investors. Thus, we propose the following hypothesis.

H1b: The number of employees will be positively associated with the funding outcome in equity crowdfunding.

3.2. Earlier Investors

Faced with potential high-risk investment decisions, current investors are likely to rely on signals from earlier investors. Previous research explained the influence of herding behaviors (Bikhchandani and Sharma 2000) and information cascade theory (Anderson and Holt, 1997) on financial markets. Likewise, confidence in investing in an early stage start-up relates to whether there are investors with business experience who have insight into running a business. In the context of equity crowd funding, we are interested in discerning who the real experts are in this market. In general, experts have a better understanding than nonexperts of product information and a better ability to distinguish between important and unimportant factors (Alba et al., 1987). However, equity crowdfunding investors may behave irrationally, reflecting the influence of herding or information cascading. Investors with business expertise can add value to a firm in the form of signaling its quality. For example, activism in firms by a partner from a venture capital firm who has business experience can have a positive relationship with the success of firms in which his or her company invests (Bottazzi et al., 2008).

Previous researchers have examined the influence of earlier investors in the crowdfunding market, and

they have tested hypotheses about how earlier investors serve as a signal to later investors based on three types of investors (Kim and Viswanathan, 2016). However, unlike our predecessors, we make a clear distinction between pure investors and business investors based on their backgrounds. Pure investors focus on investment rather than business opportunities, whereas business investors devote themselves to the exploitation of entrepreneurial opportunities. In H2a, we expect that crowd investors are more likely to prefer signals from experienced business investors. Therefore, we hypothesize,

H2a: The ratio of business investors will be positively associated with funding outcomes in equity crowdfunding.

Aside from the business investors who serve as a signal to later investors in H2a, the ratio of pure investors who do not identify themselves as experienced business investors can be associated with funding outcomes. Venture capitalists and angel investors have rapidly become important sources of financing for start-ups, especially since innovative high-tech start-ups began fundraising on equity crowdfunding platforms. Although experienced business investors have expertise in products and services, venture capitalists and angel investors have expertise derived from broader insights into the market (Kim and Viswanathan, 2016). Their investment decisions are unbiased. Thus, we propose the following hypothesis.

H2b: The ratio of pure investors will be positively associated with funding outcomes in equity crowdfunding.

3.3. Social Capital

In addition to the important roles of human capital

and earlier investors discussed above, social capital can also be a resource for a firm's valuation. Social capital refers to "the actual and potential resources individuals obtain from knowing others, being part of a social network with them, or merely from being known to them and having a good reputation" (Nahapiet and Ghoshal, 1998). This social capital has structural, cognitive, and relational dimensions (Cicourel, 1973; Nahapiet and Ghoshal, 1998; Putnam, 1995), and through the network confers access to potential customers and financial resources (Brüderl and Preisendörfer, 1998). Hence, a firm's specific investment in social capital, as well as human capital, is more influential in its performance than general investments (Bosma et al., 2004).

In addition to team members (H1a) and employees (H1b), board members and advisors are another element of the social capital important to valuation of a start-up (Ahlers et al., 2015). Although their roles and contributions are less likely to impact a firm's productivity, board members and advisors play important roles in exposing a start-up to potential investors. For example, they can introduce entrepreneurs to potential investors. Therefore, their knowledge and experience are more likely associated with a funding outcome. Similar to the way a previous study defined the ratio of nonexecutive board members as a social capital variable (Ahlers et al., 2015), this study identifies board members and advisors as social capital. Hence, we expect board members and advisors to be associated with a start-up's funding outcome.

H3a: The number of board members and advisors will be positively associated with a funding outcome in equity crowdfunding.

In the context of equity crowdfunding, the more

uncertainty investors face at the outset, the more likely the startup is to fail at attracting investors. Most equity crowdfunding platforms allow users to subscribe to receive start-ups' updates by "following" them. This is an important benefit to crowdfunding investors to let them know how many audiences are interested in a firm. In this manner, Followers are important online social capital with social value (Hofer and Aubert, 2013), and this facilitates a start-up's funding outcome in terms of its social capital. Furthermore, the more followers a start-up has, the more opportunities it has to highlight its information on equity crowdfunding, which is likely to have positive effects on online social capital (Hofer and Aubert, 2013). Thus, we propose the following hypothesis.

H3b: A start-up's social capital will be positively associated with funding outcomes in equity crowdfunding.

Applying the concept of social capital to equity crowdfunding, the social capital of an earlier investor gives a company plays an essential role in its valuation. This social capital refers to the number of followers on an equity crowdfunding platform. Because crowd investors have herding and cascading-like behaviors, an investor with many followers is likelier to result in more exposure to potential investors. For example, the more followers a company on the crowdfunding platform has, the greater the opportunity to obtain a favorable funding outcome. Previous research has confirmed the important role of reputable investors in the success of a mobile app (Kim and Viswanathan, 2016). If the earlier investors have high social capital, such as a large number of followers, then a firm is likely to have a higher funding outcome. However, this important interplay between the earlier investors' social capital and funding has not been fully probed.

In H3c, we examine the social capital of investors and hypothesize a positive relationship between the average influence level of investors and a start-up's funding outcome. Whereas previous research has focused on how earlier investors can influence sales performance and later investors (Burtch et al., 2011; Kim and Viswanathan, 2016), we focus on how the level of earlier investor's social capital is associated with a funding outcome. Thus, we propose the following hypothesis.

H3c: An Investors' social capital will be positively associated with funding outcomes in equity crowdfunding.

IV. Research Context and Data

4.1. Research Context and Data Collection

We collected data from AngelList, a large global equity crowdfunding platform. AngelList was founded in 2010, and as of December 2014, it had more than 397,000 companies and 840,000 users. As both a start-up social networking and equity crowdfunding platform, the site attracts investors, start-ups, venture capitalists, incubators, and accelerators by providing industrial information. Because start-ups' characteristics and funding outcomes vary by industry, we focused on the mobile industry in the United States.

We collected our data using a crawler we developed to parse web pages and an application programming interface (API). Most data sets were collected in a structured data format that was provided by AngelList. For instance, funding outcomes, investors' occupations, followers, and the number of published news items were obtained from the API. Besides obtaining data through the API, we also have crawled data from the AngelList website to get the full list

of mobile industry start-ups. The final data set contains 1,111 companies, 11,969 user profiles, and 19,677 linked data among companies and users.

To examine the factors related to funding outcomes, we excluded start-ups with no funding activities. Users' profile data are publicly available; thus, we created a company-user linked data set to derive variables related to earlier investors' types and occupations: Pure Investors (Advisors, Attorneys, Angels, Investors, and Venture Capitalists), Business Investors (Designers, Developers, Entrepreneurs, Marketing, Operations, Project Management, and

Sales) (see <Table 2>). We collected the data in December 2014, and it contains enough records to answer our research questions.

<Table 3> contains summary statistics of start-up distribution by current funding stage and provides an initial look at the data we used in our research. The data set contains various and detailed information about start-ups and users. Our study focuses on early stage start-ups (Seed and Series A), and the Seed stage has the most observations ($N = 687$) of all. Most of the variables in Seed are smaller than in the other stages because it is the earliest

<Table 2> Summary of Previous Research on Crowdfunding

Research	Objective	Context	Findings
Agrawal et al. (2014)	To investigate the underlying economics of crowdfunding and construct a framework for speculating on equity crowdfunding	Kickstarter.com	The future of crowdfunding is hard to predict. However, crowdfunding platforms will solve many problems through innovation.
Ahlers et al. (2015)	To investigate how human capital, social capital, and uncertainty influence fundraising success	ASSOB (assob.com.au)	Human capital and level of uncertainty have an impact on funding success. However, social capital and intellectual capital have little or no impact on funding success.
Belleflamme et al. (2014)	To compare preordering and profit sharing projects on crowdfunding	Kickstarter.com	Crowdfunding allows for price discrimination: therefore, preordering of projects is preferred because of the small initial capital requirement.
Butticè et al. (2017)	To investigate whether serial entrepreneurs take advantage of social contacts from their previous campaigns	Kickstarter.com	Internal social capital is related to the success of serial crowdfunders.
Cholakova and Clarysse (2015)	To investigate how financial or nonfinancial motivations determine investing decisions	Symbid	Nonfinancial motives play no significant role. However, equity investing is a positive predictor of keeping a pledge.
Kim and Viswanathan (2016)	To examine the role of early investors' expertise as a signal of quality for later investors in an online crowdfunding market	Appbackr	Inexperienced decisions are highly influenced by experts participating the market.
Mollick, E. (2014)	To investigate the underlying dynamics of crowdfunded ventures	Kickstarter.com	Project quality serves as a quality signal to be funded.
Vismara (2016)	To investigate the signaling role of entrepreneurs' social capital	Crowdcube and Seedrs	Entrepreneurs' social capital has a positive impact on funding success.

<Table 3> Summary Statistics: Start-up Distribution by Current Stage

Variable	All	Seed	Series A	No Stage
Funding outcome (cumulative)	4,205,820	1,212	10,819	3,108
<i>Human capital</i>				
Current Members	2.42	1.71	3.71	2.26
Employees (4 pt int. scale)	1.32	1.16	1.75	1.27
<i>Earlier investor</i>				
Business investors	1.86	1.43	2.75	1.46
Pure investors	3.13	2.11	5.26	2.51
Other investors	1.32	1.09	1.63	1.47
<i>Social capital</i>				
Board & advisors	0.72	0.38	1.48	0.70
Investors' social capital	835.88	636	1,440	491
Start-up's social capital	119.90	91.79	189.56	78.66
<i>Control variables</i>				
Past team members	0.87	0.45	1.65	0.81
Published news	2.12	0.89	3.06	1.01
Quality score	5.92	5.45	7.34	5.34
Total	1,111	687	167	169

stage. Our unique data set includes start-ups' accumulated funding outcomes, human capital, earlier investors, and quality scores from AngelList. Funding Outcome has an average of \$4,205,820, and start-ups generally have more Pure Investors (mean = 3.13 people) than Business Investors (mean = 1.86 people).

4.2. Variables

Our data allow company-level analysis in the U.S. mobile industry to determine whether a specific start-up's characteristics (e.g., human capital, earlier investors' experience, and social capital) are associated with a funding outcome. The dependent variable is Funding, which is the cumulated funding amounts raised from the seed to the current funding stage. <Table 4> summarizes the variables used in our analysis and shows summary statistics for all

the observations. Funding stage is the start-up's current fundraising round, classified into seven common categories: Seed, Series A, Series B, Series C, Series D, Acquired, IPO, and No Stage. Series A - D are sequential stages, whereas Seed and Acquired are not. Seed is the earliest, but not mandatory, stage. Start-ups in the Seed stage also have earlier investors (see <Table 3>) because their funding outcomes are the sum of all fundraising activities since the formation of a corporation. Because this study focuses on early stage start-ups, firms in the Series B, Series C, Series D, Acquired (acquisition), and IPO (initial public offering) stages are excluded from the analysis.

From the human capital perspective, we examined two variables: Current Members and Employees. Current Members reflect the number of people in management, whereas Employees is the number of people currently employed as part-time or full-time

<Table 4> Variable Description and Summary Statistics ($N = 1,111$)

Variable		Description	Mean	SD	Min	Max
Human capital	Current members	Number of current members	2.42	3.31	0	30
	Employees	Number of employees (4 point interval scale)	1.32	0.56	1	4
Earlier investor	Pure investors	Proportion of investors who previously have no business experience	31.83	35.06	0	100
	- <i>Advisors</i>	Proportion of investors who are advisors	0.79	5.22	0	100
	- <i>Attorneys</i>	Proportion of investors who are attorneys	0.34	3.86	0	100
	- <i>Angels</i>	Proportion of investors are who angels	18.50	26.19	0	100
	- <i>Investors</i>	Proportion of investors who are investors	5.66	14.88	0	100
	- <i>Venture capitalists</i>	Proportion of investors who are venture capitalists	6.43	16.11	0	100
	Business investors	Proportion of investors who previously have business experience	20.42	29.46	0	100
	- <i>Designers</i>	Proportion of investors who are designers	0.26	2.57	0	50
	- <i>Developers</i>	Proportion of investors who are developers	1.35	8.01	0	100
	- <i>Entrepreneurs</i>	Proportion of investors who are entrepreneurs	15.23	26.16	0	100
	- <i>Marketing</i>	Proportion of investors who are marketers	0.69	5.48	0	100
	- <i>Operations</i>	Proportion of investors who are operations experts	0.92	4.56	0	50
	- <i>Project management</i>	Proportion of investors who are project managers	1.23	6.69	0	100
	- <i>Sales</i>	Proportion of investors who are in sales	0.45	4.22	0	100
Social capital	Board & advisors	Number of board members and advisors	0.72	1.73	0	20
	Start-up's social capital	Number of followers who subscribe to start-up's information	42.97	29.50	4	491
	Investor's social capital	Cumulative number of investors' followers	10,344	26,304	0	230,071
Control variable	Past team members	Number of past team members	0.87	2.51	0	31
	Published news	Number of news items published about start-up	2.12	14.99	0	449
	Quality score	Start-up quality measured by Angellist (1 - 10)	5.92	2.20	1	10

workers (staff). Current Members are usually decision makers who are founding members who may have ownership or shares of the company. In general, Current Members (manager) are in charge of managing employees.

For the variables related to earlier investors' experience, we drew a clear distinction between Pure Investors and Business Investors based on their prior experiences. To distinguish Business Investors from Pure Investors, we traced investors' past work experi-

ences and roles in their respective companies. Therefore, we define Pure Investors as investors who only have investment experience. For example, if a venture capitalist had business-related occupations, such as designer, developer, entrepreneur, marketing, operations, project management, and sales, he or she is within the category of Pure Investors. On the other hand, we defined Business Investors as investors who have both investment and business experience. Moreover, we expanded earlier investors'

experiences to their occupations. As shown in <Table 4>, we considered the occupations of investors to identify what kinds of experience are credible for investors. Pure Investors are Advisors, Attorneys, Angels, Investors, and Venture Capitalists, and Business Investors are Designers, Developers, Entrepreneurs, Marketing, Operations, Project Management, and Sales.

From the social capital perspective, we examined three variables: Board and Advisors, Start-ups' Social Capital, and Investors' Social Capital. Board and Advisors is the number of board members and advisors. Start-up's Social Capital is the number of followers who subscribe to a start-up's updated information by following it on AngelList. Start-up's Social Capital has an average of 42.97 with a standard deviation of 29.50, which indicates a huge gap between focused and unfocused start-ups. In addition, the large standard deviation (26,304) of Investor's Social Capital indicates an investment concentration on AngelList.

In addition, we have several control variables. Past Team Members reflects the number of people who were in management previously; Published News is the number of news items published about a start-up; Quality Score is a quality indicator measured by AngelList that reflects the company's rank and is updated every 48 hours. However, we excluded some vague and missing data, such as "the number of products," "the number of competitors," and "acquisitions."

V. Empirical Analysis

Our goal in this study was to identify factors associated with funding outcomes. To test our hypotheses, we estimated the regression coefficients of our ex-

planatory variables. The unit of analysis in our study is a company, and we observed various factors related to a start-up's funding outcome. The dependent variable is $\ln(\text{Funding}_i)$, the log of the cumulative funding amount of start-up i since it was founded. Our data contain several distinct observations on the funding status of an innovative high-tech start-up on an equity crowdfunding platform; therefore, our estimation equation is given by

$$\begin{aligned} \ln(\text{Funding}_i) = & a + \beta_1 \text{CurrentMembers}_i + \\ & \beta_2 \text{Employees}_i + \gamma_1 \text{BusinessInvestors}_i \\ & + \gamma_2 \text{PureInvestors}_i + \delta_1 \text{BoardsAdvisors}_i \\ & + \delta_2 \text{InvestorsSocialCapital}_i \\ & + \delta_3 \text{Start-upsSocialCapital}_i \\ & + \phi_1 \text{PublishedNews}_i \\ & + \phi_2 \text{PastTeamMembers}_i \\ & + \phi_3 \text{QualityScore}_i + \varepsilon_i \end{aligned} \quad (1)$$

where *CurrentMembers* is the number of current team members; *Employees* is the number of employees; *BusinessInvestors* is the proportion of business investors; *PureInvestors* is the proportion of pure investors; *BoardsAdvisors* is the number of board members and advisors; *InvestorsSocialCapital* is the average of all investors' followers; *Start-upsSocialCapital* is the number of users who subscribe to a start-up's information on AngelList; *PublishedNews* is the number of news items published about a start-up; *PastTeamMembers* is the number of past team members; *QualityScore* is a quality indication from AngelList; and ε is an unobserved error term representing all causes of Funding other than the main variables.

To compute *PureInvestors* and *BusinessInvestors* for Equation 1, we calculate the proportion of business or pure investors in a start-up. For example, the

total number of Business Investors is a numerator of the total number of earlier investors. To calculate the percentage, we simply multiply a proportion by 100 (see Equation 2).

$$PureInvestors_i = \frac{TotalPureInvestors_i}{TotalPastInvestors_i} \times 100\% \tag{2}$$

where *TotalPureInvestor_i* represents the total number of pure investors in start-up *i*, and *TotalPastInvestor_i* is the total number of earlier investors in start-up *i*. Moreover, we measure the average of all investors' social capital in a start-up by using the investors' average number of followers. By conducting a following-follower structure analysis on AngelList, we examined \bar{I} (*InvestorsSocialCapital_i*) as follows:

$$\bar{I} = \frac{1}{n} \sum_{i=1}^n F_i \tag{3}$$

where *F_i* denotes the number of followers (crowd) for investor *i*, and *n* is the total number of investors in a start-up.

<Table 5> Correlation Matrix and VIF

Variable	1	2	3	4	5	6	7	8	9	10	VIFs
1. Current members	1.00										1.53
2. Employees	0.38	1.00									1.33
3. Board & advisors	0.42	0.24	1.00								1.30
4. Business investor	0.01	0.03	-0.01	1.00							1.10
5. Pure investor	0.26	0.26	0.20	-0.13	1.00						1.60
6. Start-up's social capital	0.24	0.15	0.12	0.17	0.29	1.00					1.59
7. Investor's social capital	0.09	0.12	0.07	0.06	0.34	0.31	1.00				1.26
8. Published news	0.31	0.22	0.23	-0.00	0.16	0.21	0.08	1.00			1.19
9. Past members	0.43	0.40	0.35	0.01	0.23	0.16	0.09	0.31	1.00		1.42
10. Quality score	0.37	0.33	0.27	0.14	0.55	0.59	0.42	0.23	0.29	1.00	2.38

Note: Bold represents statistically significant correlation coefficients with *p* > 0.05.

VI. Results

Our analysis investigates how a start-up's underlying characteristics are associated with its funding outcome on an equity crowdfunding platform. First, we show regression results for human capital. Second, we show regression results for earlier investors' experiences. Third, we show a regression result for social capital.

<Table 5> reports the correlations between the independent variables by showing that correlations across all independent variables are less than 0.6. Additionally, we conducted variance inflation factors (VIFs) tests for multicollinearity, and all values were below the threshold of 10 (maximum VIF of 2.38). Therefore, multicollinearity is not a concern in our estimation.

6.1. Human Capital

Research Question 1: How is a start-up's human capital associated with funding outcomes in equity crowdfunding?

<Table 6> Full Model Regression

Variable		All (1)	Seed (2)	Series A (3)
Human Capital	Current members	0.0798*** (0.0176)	0.0991*** (0.0247)	0.0302 (0.0210)
	Employees	1.271*** (0.0910)	0.953*** (0.140)	0.844*** (0.112)
Earlier Investor	Business investors	-0.0026* (0.00151)	-0.000888 (0.00165)	0.00236 (0.00334)
	Pure investors	0.00496*** (0.00156)	0.00429** (0.00187)	-0.000532 (0.00239)
Social Capital	Board & advisors	0.0544* (0.0286)	0.0400 (0.0448)	0.0316 (0.0307)
	Start-up's social capital	0.000140 (0.000255)	0.000283 (0.000376)	0.000174 (0.000318)
	Investor's social capital	-0.0000465* (0.0000238)	-0.0000101 (0.0000259)	-0.0000759* (0.0000457)
Control Vars.	Published news	-0.00239 (0.00331)	0.000818 (0.0165)	0.00313 (0.00988)
	Past members	0.00852 (0.0240)	0.0406 (0.0361)	0.00534 (0.0269)
	Quality score	0.372*** (0.0305)	0.260*** (0.0374)	0.199*** (0.0490)
Constant		9.104*** (0.163)	9.818*** (0.218)	12.47*** (0.307)
R ²		0.548	0.356	0.495
N		1,085	676	158

Note: Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

<Table 6> shows the regression results for the association between start-ups' underlying characteristics and funding outcomes. The coefficient for Current Members is positive and significant (H1a: $\beta = 0.0798$ and $p < 0.01$ in the All stages), and the coefficient for Employees is also positive and significant (H1b: $\beta = 1.271$ and $p < 0.01$ in the All stages). These results strongly support both H1a and H1b, which hypothesize that human capital, such as Current Members and Employees, are positively

associated with funding outcomes. Interestingly, Current Members is associated more with a start-up's funding outcome at the Seed stage ($\beta = 0.0991$ and $p < 0.01$) than at the Series A stage, and Employees does not have a significant difference between the Seed ($\beta = 0.953$ and $p < 0.01$) and Series A stages ($\beta = 0.844$ and $p < 0.01$). Additionally, we tested the statistical difference of coefficients between Current Members and Employees, and we found that Employees has a stronger relationship than

Current Members ($p < 0.01$) with a funding outcome.

6.2. Earlier Investors

Research Question 2: How is earlier investors' experience associated with funding outcomes in equity crowdfunding?

We conducted an in-depth analysis of earlier investors to see how their experiences are related to a start-up's funding outcome. Therefore, we set out to answer the question "Who are the investing experts in the equity crowdfunding market?" In this regard, we drew a clear distinction between Pure Investors and Business Investors based on their past experiences. <Table 6> shows that, interestingly, Hypothesis 2a was supported, whereas Hypothesis 2b was not. The coefficient of Pure Investors is positive and significant, indicating that a higher proportion of Pure Investors (H3a: $\beta = 0.00496$ and $p < 0.01$ in the All stages) is associated with a start-up's Funding.

In contrast, the coefficient of Business Investors is insignificant, indicating that the proportion of Business Investors is not associated with Funding (H3b: $\beta = -0.0026$ and $p < 0.1$ in the All stages). However, we found that Business Investors has a negative relationship with a start-up's funding outcome. This result suggests that a higher level of investing participation by Pure Investors is an investing signal for later investors, but participation by Business Investors is not.

Additionally, <Table 7> shows an extended analysis of earlier investor types. Interestingly, there are clearly different results within the investor types if we categorize them by occupation. Among Pure Investors, <Table 4> shows investors who are experts in investing (Pure Investors), such as Advisors ($\beta = 0.0182$ and $p < 0.1$) Angels ($\beta = 0.0223$ and

$p < 0.01$), Investors ($\beta = 0.0214$ and $p < 0.01$), and Venture Capitalists ($\beta = 0.0479$ and $p < 0.01$) are significantly associated with Funding except Attorneys. Although H2b was not supported, the high level of investing participation by Entrepreneurs ($\beta = 0.00455$ and $p < 0.05$) and Operations Experts ($\beta = 0.0267$ and $p < 0.1$) is positively associated with funding outcomes.

6.3. Social Capital

Research Question 3: How is a start-up's social capital associated with funding outcomes in equity crowdfunding?

We examined three types of social capital on equity crowdfunding: Boards and Advisors, Start-upsSocialCapital, and InvestorsSocialCapital. The positive and significant estimate for BoardsAdvisors ($\beta = 0.0544$ and $p < 0.1$) suggests a higher probability that a start-up achieves a higher funding outcome if it has many board members and advisors. Therefore, H3a is supported. In contrast, Start-upsSocialCapital and InvestorsSocialCapital are not positively associated with funding outcomes. The insignificant result for Start-upsSocialCapital indicates that having numerous followers does not lead to investing on the equity crowdfunding platform. Surprisingly, H3c concerning investor's social capital (InvestorsSocialCapital) has a negative relationship with a start-up's funding outcome (H3c: $\beta = -0.0000465$ and $p < 0.1$). Thus, it clearly explains that the investors have higher levels of social capital might be a noise signal to future investors. Therefore, H3b and H3c are not supported.

There are potential endogeneity and causality concerns. The Employees variable could be endogenous because it could have reverse causality. To test for endogeneity, we conducted an instrument

<Table 7> Association between Earlier Investor's Occupations and Funding Outcome

Variables		All (1)	Seed (2)	Series A (3)
Pure investors	Advisors	0.0182* (0.0105)	0.0257** (0.0121)	0.0769** (0.0334)
	Angels	0.0223*** (0.00211)	0.0154*** (0.00228)	0.00387 (0.00297)
	Attorneys	-0.0000981 (0.0142)	-0.00492 (0.0124)	-0.00364 (0.0334)
	Investors	0.0214*** (0.00370)	0.0148*** (0.00410)	0.0140*** (0.00532)
	Venture capitalists	0.0479*** (0.00342)	0.0311*** (0.00452)	0.0135*** (0.00369)
Business investors	Designers	0.0333 (0.0214)	0.0233 (0.0208)	-0.0160 (0.0343)
	Developers	-0.00365 (0.00686)	-0.00570 (0.00601)	0.0363 (0.0227)
	Entrepreneurs	0.00455** (0.00211)	0.00296 (0.00208)	0.00881** (0.00414)
	Marketers	0.00772 (0.0100)	0.0126 (0.00923)	0.0493** (0.0247)
	Operations	0.0267** (0.0122)	0.0137 (0.0111)	0.0903*** (0.0253)
	Project managers	0.0125 (0.00821)	0.00950 (0.00736)	0.0106 (0.0198)
	Sales	0.0185 (0.0132)	0.0224* (0.0117)	-0.0610 (0.0455)
Constant		12.32*** (0.0863)	12.11*** (0.0853)	14.79*** (0.174)
R ²		0.247	0.158	0.255
N		1,111	687	167

Note: Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

variable regression using a two-stage least squares (2SLS) estimation model. We chose two instrumental variables: a start-up's age and a founder's total items. These variables are correlated with Employees (the number of employees), but are uncorrelated with the error terms of funding outcome. We performed an overidentification restriction by using the Sargon

test. The p-value of 0.8487 indicates that the null hypothesis cannot be rejected, thus the instrument variables are validated. As <Table 8> shows, our result remains consistent with the instrumental variables. Therefore, the potential endogeneity is insignificant. <Table 9> summarizes the results of hypothesis testing.

<Table 8> The Results of Instrumental Variable Regression

	Employees	Employees with IV
Employees	1.271*** (0.0910)	3.664*** (1.041)
Observations	1,111	500
Other covariates	Yes	Yes
χ^2 <i>p</i> -value	0.002	0.030

Note: Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

<Table 9> The Results of Hypotheses Testing

	Hypothesis	Supported?
Human capital	H1a: The number of current members will be positively associated with funding outcomes in equity crowdfunding.	Yes
	H1b: The number of employees will be positively associated with funding outcomes in equity crowdfunding.	Yes
Earlier investors	H2a: The ratio of business investors will be positively associated with funding outcomes in equity crowdfunding.	No (inverse)
	H2b: The ratio of pure investors will be positively associated with funding outcomes in equity crowdfunding.	Yes
Social capital	H3a: The number of board members and advisors will be positively associated with funding outcomes in equity crowdfunding.	Yes
	H3b: A start-up's social capital will be positively associated with funding outcomes in equity crowdfunding.	No
	H3c: An investor's social capital will be positively associated with funding outcomes in equity crowdfunding.	No (inverse)

VII. Discussion and Implications

7.1. Discussion of Findings

This research has produced several key findings. First, we found that human capital factors, such as Current Members and Employees, are associated with a start-up's funding outcome. This is consistent with prior research that discussed the importance of human capital (Busenitz et al., 2005; Bernstein et al., 2016; Lucas, 1988; Lucas, 1990; Penrose, 1950).

Further, our study divided human capital into two groups (Current Members and Employees). Although we found both types of human capital are positively associated with a start-up's funding outcome, Employees had a stronger relationship with funding outcome than Current Members. This approach incorporates relevant human capital measures to investigate the funding outcome of innovative high-tech start-ups on equity crowdfunding platforms.

Second, we examined how earlier investors' experiences are associated with funding outcomes. A high level of participation by Pure Investors had a positive relation to a funding outcome, but the participation

of Business Investors was insignificantly related to funding outcome. Additionally, our in-depth analysis by occupation indicates that among Pure Investors, only Angels, Investors, and Venture Capitalists are significantly associated with funding outcome. This is because Pure Investors are better investment experts than Business Investors, and one possible explanation is that Business Investors are more likely to have a selection bias when they choose start-ups for investments. The possible extension is related to literature on signaling theory (Connelly et al., 2011; Pollock and Gulati, 2007; Spence, 1973) and valuation of firms (John et al., 1994; Penrose, 1959; Teece et al., 1997). For example, the participation of professional investors such as Pure Investors can be a quality signal for later investors because they have more insight into the market and how firms are valued.

Third, we examined whether Investor's Social Capital is associated with funding outcome. Our analyses revealed that Investor's Social Capital serves as a noise signal to later investors in an equity crowdfunding context. Several studies have discussed the importance of online social capital in an online context (Chung et al., 2012; Gerrit et al., 2015; Hofer and Aubert, 2013; Lee et al., 2015; Nguyen et al., 2006), and in a large market inexperienced investors have a strong tendency to join the herd (Burtch et al., 2011). The possible extension is related to herding (Bikhchandani and Sharma, 2000; Burtch et al., 2011) and information cascading-behaviors (Anderson and Holt, 1997). For example, an investor with many followers is likelier to have more opportunities for exposure to potential investors. However, our result indicates that an investor have higher levels of social capital can be a noise signal for an investment decision.

7.2. Implications for Research and Practice

Our results have interesting implications for both research and practice in several ways. Overall, the most important contribution of our study lies in bridging different streams of literature on signaling theory (Ahlers, 2015; Connell et al., 2011; Gregg and Walczak, 2010; Pollock and Gulati, 2007; Spence, 1973), crowdfunding (Burtch et al., 2011; Kim and Viswanathan, 2016), and firm valuation (Coleman, 1988; Damodaran, 2009; Hofer and Aubert, 2013). This contribution comes through investigating the factors related to funding outcomes in the context of equity crowdfunding.

First, this study has added to the literature on signaling theory (Spence, 1973) and crowdfunding by identifying key signals in the equity crowdfunding market. Signaling theory has been studied by various researchers (Ahlers, 2015; Connelly et al., 2011; Kim and Viswanathan, 2016; Pollock and Gulati, 2007). Specifically, our study empirically identifies the investing signals of tech start-ups (mobile industry), which are innovative and entrepreneurial. Prior studies (Coleman, 1988; Hofer and Aubert, 2013) found the importance of perceived bridging and bonding online social capital by differentiating between followers and followees. Instead, our results show that a higher level of investing participation by influential investors is negatively associated with a funding outcome. This indicates that in equity crowdfunding a high level of online social capital can serve as a noise signal rather than a quality signal. In addition, our study focuses on two types of experienced investors: Pure Investors and Business Investors. Based on our findings, Pure Investors have more investing experience than Business Investors. One possible explanation is that Business Investors are more likely to have a selection bias when they choose start-ups for

investments. Moreover, Angels, Investors, and Venture Capitalists have the best investing insights among the Pure Investors. Although Pure Investors have less selection bias overall, professional Pure Investors (Angels, Investors, and Venture Capitalists) have better investing insights than nonprofessional investors (Advisors and Attorneys).

Second, our study has extended understanding of the role of human capital assets (Penrose, 1950) in the valuation of start-ups (Damodaran, 2009) by providing new approaches to assess a firm's underlying characteristics, such as human capital and earlier investors. Several studies have used business performance factors such as sales data. Unlike prior work (Kim and Viswanathan, 2016), we have focused on factors related to business success instead of performance. Consistent with the prior literature on a firm's valuation (Damoran, 2009; Jennex et al., 2004; Kundisch and Zorzi, 2012; Lucas, 1988; Lucas, 1990), our results show that human capital and earlier investors are a firm's growth factors. Our finding provides the critical insight that human capital and earlier investors should not be overlooked or underestimated in the valuation of innovative tech start-ups.

Third, the findings in this study contribute to the current research literature on social capital. Social capital was rarely empirically examined in previous research because of its ambiguous definition and data limitations. For example, a previous study measured the share of nonexecutive directors on a venture's board as social capital (Ahlers et al., 2015). Instead, our study demonstrates that entrepreneurs' or investors' social skills are the better measures of social capital. Therefore, we measured the number of followers of a firm or investor. This study shows that board and advisors as social capital has a positive relation to a funding outcome, but start-up's social capital and investor's social capital do not.

This study also has several practical implications. First, for start-ups, obtaining funds from investors is an important strategy that can promote innovation and sustainability. Our study suggests that human capital management and quality signal building are important to maximize funding outcomes by understanding what can attract investors (Penrose, 1950). Hence, start-ups may need to adjust their efforts at enhancing how investors perceive the value of their human capital assets. When investors know that a start-up has a high level of human capital compared with its competitors, they are more confident about their decision to invest in it. Moreover, start-ups could use online start-up social networking or crowdfunding platforms to promote their potential to investors.

Second, our study has implications for investors, who should be cautious when they participate in online investing via crowdfunding platforms because people are more likely to become confused by information overload. Instead, investors can use online start-up and crowdfunding platforms as tools for start-up valuation, investment strategies, and portfolio management (Lee et al., 2014). For example, investors should know that strong human capital can leverage a start-up's potential and that earlier investments from Pure Investors are credible quality signals of a start-up's future success.

Third, our study has implications for providers of online equity crowdfunding and start-up social networking services. Online start-up platforms increase the digital visibility of start-ups and users. Providing high-quality information is obviously valuable for both start-ups and investors because the depth of information helps investors to make rational decisions (Huang et al., 2017). We hope our work contributes to a better understanding of credible key signals in the context of the equity crowdfunding

market and generates further interest in this exciting domain.

7.3. Limitations and Future Research

This study has several limitations that need to be considered. First, our measure of a dependent variable, Funding Outcome, is not directly related to the business success of a start-up (Porter, 1980). Successful funding does not always lead companies to business success; therefore, some caution should be taken in generalizing our results to U.S. mobile start-ups. Also, we did not consider start-ups' business performance factors, such as revenue, profitability, and market share, which prior research suggests are related to business performance (Kim and Viswanathan, 2016). Second, our data are cross-sectional

and focus mainly on early-stage start-ups in the mobile industry. Such data require cautious interpretation. Therefore, the issue of endogeneity and unobserved heterogeneity may not be fully resolved because of limitations of the data. In future studies, we will further examine panel data to capture longitudinal variance across several months. Third, we did not consider proximity or homophily effects in this study. Thus, in a future study, we are interested in studying herding and homophily behaviors by investigating college, past work, and location information as key factors. Lastly, this study did not consider the quality of start-up members, such as extensive experience of the domain due to the limitation of the data. Therefore, we will further examine the quality of team members of start-up as human capital.

<References>

- [1] Agrawal, A., Catalini, C., and Goldfarb, A. (2014). Some simple economics of crowdfunding. *Innovation Policy and the Economy*, 14(1), 63-97.
- [2] Agrawal, A., Catalini, C., and Goldfarb, A. (2011). The geography of crowdfunding. *National Bureau of Economic Research Working Paper Series*, (No.16820), 1-57.
- [3] Ahlers, G. K. C., Cumming, D., Günther, C., and Schweizer, D. (2015). Signaling in equity crowdfunding. *Entrepreneurship Theory and Practice*, 39(4), 955-980.
- [4] Alba, J. W., and Hutchinson, J. W. (1987). Dimensions of consumer expertise. *Journal of Consumer Research*, 13(4), 411-454.
- [5] Anderson, L. R., and Holt, C. A. (1997). Information cascades in the laboratory. *The American Economic Review*, 87(5), 847-862.
- [6] An, J., Jung, W., and Kim, H. W. (2015). A green flag over mobile industry start-ups: Human capital and past investors as investment signals. *PACIS 2015 Proceedings*, Singapore.
- [7] AngelList (2014). *Investor Accreditation Reports*. Retrieved from <http://www.angel.co>
- [8] Baron, R. A., and Markman, G. D. (2003). Beyond social capital: The role of entrepreneurs' social competence in their financial success. *Journal of Business Venturing*, 18(1), 41-60.
- [9] Baron, R. A., and Markman, G. D. (2000). Beyond social capital: How social skills can enhance entrepreneurs' success. *Academy of Management Perspectives*, 14(1), 106-116.
- [10] Belleflamme, P., Lambert, T., and Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*, 29(5), 585-609.
- [11] Bernstein, S., Korteweg, A., and Laws, K. (2016). Attracting early-stage investors: Evidence from a randomized field experiment. *The Journal of Finance*.
- [12] Bikhchandani, S., and Sharma, S. (2000). Herd behavior in financial markets. *IMF Staff Papers*, 47(3), 279-310.
- [13] Bosma, N., van Praag, M., Thurik, R., and de Wit, G. (2004). The value of human and social capital

- investments for the business performance of startups. *Small Business Economics*, 23(3), 227-236.
- [14] Bradford, C. S. (2012). Crowdfunding and the federal securities law. *Columbia Business Law Review*, 2012, 150.
- [15] Burtch, G. (2011). Herding behavior as a network externality. *Proceedings of the 32nd International Conference on Information Systems (ICIS)*, Shanghai, China
- [16] Burtch, G., Ghose, A., and Wattal, S. (2013). An empirical examination of users' information hiding in a crowdfunding context. *Proceedings of the 32nd International Conference on Information Systems (ICIS)*, Shanghai, China
- [17] Burtch, G., Ghose, A., and Wattal, S. (2014). An empirical examination of peer referrals in online crowdfunding. *Proceedings of the 35th International Conference on Information Systems (ICIS)*, Auckland, New Zealand.
- [18] Busenitz, L. W., Fiet, J. O., and Moesel, D. D. (2005). Signaling in venture capitalist-new venture team funding decisions: Does it indicate long-term venture Outcomes? *Entrepreneurship Theory and Practice*, 29(1), 1-12.
- [19] Butticiè, V., Colombo, M. G., and Wright, M. (2017). Serial crowdfunding, social capital, and project success. *Entrepreneurship Theory and Practice*, 1-25.
- [20] Cholakova, M., and Clarysse, B. (2015). Does the possibility to make equity investments in crowdfunding projects crowd out reward-based investments? *Entrepreneurship Theory and Practice*, 39(1), 145-172.
- [21] Chung, N., Han, H. J., and Koo, C. (2012). Mediating roles of attachment for information sharing in social media: Social capital theory perspective. *Asia Pacific Journal of Information Systems*, 22(4), 101-123.
- [22] Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, 94, S95-S120.
- [23] Connelly, B. L., Certo, S. T., Ireland, R. D., and Reutzel, C. R. (2011). Signaling theory: A review and assessment. *Journal of Management*, 37(1), 39-67.
- [24] Damodaran, A. (2009). *Valuing Young, Start-up and Growth Companies: Estimation Issues and Valuation Challenges*. Stern School of Business, New York University (New York).
- [25] Dholakia, U. M., Basuroy, S., and Soltysinski, K. (2002). Auction or agent (or both)? A study of moderators of the herding bias in digital auctions. *International Journal of Research in Marketing*, 19(2), 115-130.
- [26] Edralin, D. M. (2007). Human capital development for innovation in Asia: Training and development practices and experiences of large philippine companies. *Asian Journal of Technology Innovation*, 15(1), 133-147.
- [27] Garnsey, E. (1998). A theory of the early growth of the firm. *Industrial and Corporate Change*, 7(3), 523-556.
- [28] Gerber, E. M., Hui, J. S., and Kuo, P. Y. (2012). Crowdfunding: Why people are motivated to post and fund projects on crowdfunding platforms. In *Proceedings of the International Workshop on Design, Influence, and Social Technologies: Techniques, Impacts and Ethics*.
- [29] Gregg, D. G., and Walczak, S. (2010). The relationship between website quality, trust and price premiums at online auctions. *Electronic Commerce Research*, 10(1), 1-25.
- [30] Hemer, J. (2011). A Snapshot on crowdfunding. *Working papers firms and region*. (No. R2/2011).
- [31] Hofer, M., and Aubert, V. (2013). Perceived bridging and bonding social capital on twitter: Differentiating between followers and followees. *Computers in Human Behavior*, 29(6), 2134-2142.
- [32] Huang, H., Li, Y., and Zhang, Y. (2017). Investors' attention and overpricing of IPO: An empirical study on China's growth enterprise market. *Information Systems and E-Business Management*.
- [33] Huang, Y., Shen, C., and Contractor, N. S. (2013). Distance matters: Exploring proximity and homophily in virtual world networks. *Decision Support Systems*, 55(4), 969-977.
- [34] Ibrahim, N. (2012). The model of crowdfunding

- to support small and micro businesses in Indonesia through a web-based platform. *Procedia Economics and Finance*, 4, 390-397.
- [35] Jennex, M. E., Amoroso, D., and Adalakun, O. (2004). E-commerce infrastructure success factors for small companies in developing economies. *Electronic Commerce Research*, 4(3), 263-286.
- [36] Lee, E. B., Lee, J. B., and Yang, C. G. (2014). A study on investment decision making criterion based on crowd funding. *Information Systems Review*, 16(2), 25-41.
- [37] Lee, K. D., Jung, C. H., and Kim, Y. J. (2015). Capability, service orientation, and performance in the investment management industry. *Asia Pacific Journal of Information Systems*, 25(3), 597-625.
- [38] Lee, S. H., Seo, D. B., Kim, T. S. (2015). Popularity versus influence on SNS. *Information Systems Review*, 17(3), 183-202.
- [39] Leimeister, J. M. (2010). Collective intelligence. *Business & Information Systems Engineering*, 2(4), 245-248.
- [40] Ley, A., and Weaven, S. (2011). Exploring agency dynamics of crowdfunding in start-up capital financing. *Academy of Entrepreneurship Journal*, 17(1), 85.
- [41] Lin, M., and Viswanathan, S. (2016). Home bias in online investments: An empirical study of an online crowdfunding market. *Management Science*, 62(5), 1393-1414.
- [42] Lucas, R. E. (1990). Why doesn't capital flow from rich to poor countries? *The American Economic Review*, 80(2), 92-96.
- [43] Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1), 3-42.
- [44] Kim, K., and Viswanathan, S. (2016). The "Experts" in the crowd: The role of "Expert" investors in a crowdfunding market. *TPRC 41: The 41st Research Conference on Communication, Information and Internet Policy*.
- [45] Kittur, A., and Kraut, R. E. (2008). Harnessing the wisdom of crowds in Wikipedia. In *Proceedings of the ACM 2008 conference on Computer supported cooperative work - CSCW '08* (p. 37). New York, New York, USA: ACM Press.
- [46] Kundisch, D., and Zorzi, R. (2012). Enhancing the quality of financial advice with web 2.0: An approach considering social capital in private asset allocation. *Information Systems and E-Business Management*, 10(1), 85-99.
- [47] MacMillan, I. C., Siegel, R., and Narasimha, P. S. (1986). Criteria used by venture capitalists to evaluate new venture proposals. *Journal of Business Venturing*, 1(1), 119-128.
- [48] Massolution 2015. 2015CF. The crowdfunding industry report. Massolution Report. 2015.
- [49] Mollick, E. (2014). The dynamics of crowdfunding: An exploratory study. *Journal of Business Venturing*, 29(1), 1-16.
- [50] Nahapiet, J., and Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review*, 23(2), 242-266.
- [51] Nguyen, L., Torlina, L., Peszynski, K., and Corbitt, B. (2006). Power relations in virtual communities: An ethnographic study. *Electronic Commerce Research*, 6(1), 21-37.
- [52] OECD (2011). *Financing high-growth firms*. OECD Publishing.
- [53] Penrose, E. T. (1959). *The theory of the growth of the firm*. Oxford University Press, USA.
- [54] Pollock, T. G., and Gulati, R. (2007). Standing out from the crowd: The visibility-enhancing effects of ipo-related signals on alliance formation by entrepreneurial firms. *Strategic Organization*, 5(4), 339-372.
- [55] Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. New York: Free Press.
- [56] Salminen, J. (2014). *Startup dilemmas: Strategic problems of early-stage platforms on the internet*. Turku School of Economics.
- [57] Schwienbacher, A., and Larralde, B. (2010). Crowdfunding of small entrepreneurial ventures.

Handbook of Entrepreneurial Finance, Oxford University Press.

- [58] Shane, S., and Venkatarman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review*, 25(1), 217-226.
- [59] Son, J.-E., Lee, S.-H., Cho, E.-Y., and Kim, H.-W. (2016). Examining online citizenship behaviours in social network sites: A social capital perspective. *Behaviour & Information Technology*, 35(9), 730-747.
- [60] Spence, M. (1973). Job market signaling. *The quarterly journal of Economics*, 87(3), 355-374.
- [61] Stemler, A. R. (2013). The JOBS act and crowdfunding: Harnessing the power—and money—of the masses. *Business Horizons*, 56(3), 271-275.
- [62] Teece, D. J., Pisano, G., and Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.
- [63] Van Gelderen, M., Thurik, R., and Bosma, N. (2005). Success and risk factors in the pre-startup phase. *Small Business Economics*, 24(4), 365-380.
- [64] Vismara, S. (2016). Equity retention and social network theory in equity crowdfunding. *Small Business Economics*, 46(4), 579-590.
- [65] Voelker, T. A., and McGlashan, R. (2013). What is crowdfunding? Bringing the power of kickstarter to your entrepreneurship research and teaching activities. *Small Business Institute Journal*, 9(2), 11-22.
- [66] Wilson, K. E., and Testoni, M. (2014). Improving the role of equity crowdfunding in Europe's capital markets. *Bruegel Policy Contribution*, 2014(9).
- [67] Xiang, G., Zheng, Z., Wen, M., Hong, J. I., Rosé, C. P., and Liu, C. (2012). A supervised approach to predict company acquisition with factual and topic features using profiles and news articles on techcrunch. In *ICWSM*.

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Submitted: September 30, 2018; 1st Revision: January 28, 2019; Accepted: February 12, 2019