When Does Crowdsourcing Benefit Firm Stock Market Performance?

Abstract

Crowdsourcing is a particular form of open innovation (OI) that aims to boost idea-generation in innovation processes. The underlying rationale is that the collective intelligence of a large number of contributors outside the firm's boundaries increases the likelihood of achieving 'extreme outcomes', i.e., high quality ideas with exceptional business potential. Due to the idiosyncrasies that differentiate crowdsourcing from other forms of OI, the findings from prior research on the performance implications of OI cannot be directly extended to crowdsourcing. Similarly, the findings on the effect of internal R&D on firm performance cannot be directly applied to crowdsourcing due to the greater uncertainty in dealing with a crowd of unknown individuals outside the organization whose ideas have to be evaluated and ultimately processed internally. Thus, while crowdsourcing research has recently burgeoned, it is ambiguous as to whether and when crowdsourcing is beneficial for firms. In fact, the overall effect of crowdsourcing on a firm's future profits has not been thoroughly investigated. To fill this gap, we conducted an event study analyzing stock market reactions to crowdsourcing announcements, a forward-looking market-based measure able to isolate the effect of crowdsourcing on a firm's future profits, which we refer to as firm stock market performance. Drawing on the resource-based view, we argue that an external crowd can become a valuable resource if the firm is able to extract value from it. Our findings show that two key contingency factors, i.e., brand value and investment opportunities, determine the boundary conditions that enable firms to extract value from the crowd, resulting in a positive stock market reaction to the announcement of a crowdsourcing campaign. In addition to advancing scholarly knowledge on crowdsourcing, our results provide practitioners with relevant indications for profitable crowdsourcing campaigns.

Keywords: Crowdsourcing, Open Innovation, R&D, Stock market performance, Brand value, Investment opportunities.

1. Introduction

At the beginning of the 16th century, trade between Europe, the new American, and Indian colonies was flourishing. Transoceanic voyages, however, were exceptionally dangerous at the time, since there was no reliable methodology to determine the exact location of a vessel in the open sea. This situation was referred to as 'the longitude problem', which was not resolved until the second half of the 18th century. Remarkably, the solution did not come from a physicist, naval engineer, or leading scientist, such as Isaac Newton, studying this problem at the time. The 'sea watch' was instead invented by John Harrison, a working-class clockmaker, who was seduced by the rich monetary reward that the Longitude Act offered anyone who could solve this problem. This law, passed by the British Parliament in July 1714, was the first historical account of what is now referred to as crowdsourcing (Howe, 2006).

Crowdsourcing, which is a particular form of open innovation (OI) (Bogers et al., 2017; Enkel et al., 2009; West et al., 2014) involving dispersed individuals from outside the firm's boundaries is well described by Brabham (2008) as "the process of posting a problem online, having a vast number of individuals offering solutions and awarding the winning ideas with some form of a bounty". Recent advancements in information technologies (Ford et al., 2015; Franzoni and Sauermann, 2014; Garcia Martinez, 2015; Majchrzak and Malhotra, 2013; Mina et al., 2014) allow an even larger number of people to be involved in crowdsourcing campaigns, granting access to a wide array of external expertise and knowledge (Bayus, 2013; Schenk and Guittard, 2011). In fact, online participation through web-based platforms facilitates collaborations with widely dispersed individuals by overcoming social, cultural, and geographical barriers (Cappa et al., 2016). While it took the British Parliament over fifty years to solve the longitude problem, crowdsourcing campaigns today can last just a few

months, collecting thousands of contributions, i.e., ideas (Bayus, 2013; Brabham, 2008; Howe, 2006; Poetz and Schreier, 2012; Schemmann et al., 2016).

Crowdsourcing may foster the firm's innovation capacity, since external resources grant access to knowledge, skills, and expertise that are not present within the firm's boundaries (Afuah and Tucci, 2012; Magnusson, 2009; Poetz and Schreier, 2012; Randhawa et al., 2016; Schemmann et al., 2016; Xu et al., 2015). By extending or renewing the firm's existing knowledge stocks, the use of external resources from the crowd to find a solution to a given problem can help firms innovate.

However, crowdsourcing differs from other forms of OI for a number of reasons. First, the firm engaging in crowdsourcing typically interacts with a much higher number of outside entities – the crowd oftentimes consists of thousands of dispersed individuals – than in other forms of OI (Afuah and Tucci, 2012; Schenk and Guittard, 2011). For this reason, crowdsourcing also entails distinctive costs related to the resources used to administer the online campaign and to evaluate the submitted proposals (Afuah and Tucci, 2012; Blohm et al., 2013; Caputo et al., 2016). Second, crowdsourcing does not expose firms to disputes related to intellectual property rights on innovations developed based on the contributions collected (Mortara et al., 2013). In fact, participants contributing to a firm's call for ideas relinquish any rights on the innovation outcomes developed. Finally, crowdsourcing also differs from internal R&D, since its results are based on ideas from an unknown crowd outside the firm's boundaries rather than on internal efforts, and are hence more uncertain.

As such, the findings from OI and internal R&D studies cannot be directly applied to crowdsourcing. For this reason, research on crowdsourcing has burgeoned in recent years, spanning from studies developing taxonomies of this phenomenon (Blohm et al., 2013; Estellés-Arolas and González-Ladrón-de-Guevara, 2012; Penin and Burger-Helmchen, 2011; Schenk and Guittard, 2011) to research attempting to assess the quality of the contributions

collected from crowds (Bayus, 2013; Poetz and Schreier, 2012). Indeed, to our best knowledge, only Xu et al. (2015) attempt to assess the effects of crowdsourcing on firm performance measured in relation to competitors through self-reported assessments. However, their study is limited to the Chinese context and uses a survey-based measure of perceived firm performance. Moreover, they do not analyze the contingencies of the effect of crowdsourcing on firm performance. Thus, we still lack a full understanding of whether and under which conditions crowdsourcing may be beneficial or not to firm performance (Bogers et al., 2010).

To fill this gap, our study aims to answer the following research question: *When does crowdsourcing benefit firm stock market performance?* To answer this question, similarly to studies that analyze the impact of R&D on firm performance (Kelm et al., 1995; Mc Namara and Baden-Fuller, 2007; Woolridge and Snow, 1990), we focus on the impact of crowdsourcing on the firm's future profits through a forward-looking measure of firm stock market performance (i.e., stock price reactions to crowdsourcing announcements). To assess the impact of crowdsourcing on a firm's future profits, we conducted an event study, a methodology widely used to assess the effects of the announcement of a firm's decisions on its future profits (Faccio and Stolin, 2006; Mc Namara and Baden-Fuller, 2007; Narayanan et al., 2000). The signaling of the announcement of a crowdsourcing campaign positively affects stock prices if conducive to profits. We contend that this occurs when firms are able to extract value from the crowd of dispersed individuals through collecting high quality ideas and effectively processing such ideas for commercial purposes (Shukla et al., 2015).

Thus, the crowd is conceived as a distinctive external resource the firm can use to achieve higher future profits, and we draw on the resource-based view (Barney, 1991; Wernerfelt, 1984) to examine when crowdsourcing allows a firm to extract value from the crowd. Based on this theoretical premise, we argue that it is possible to extract value from the crowd by

maximizing the number of individuals responding to the call for ideas, as this will likely lead to a higher number of contributions, in turn leading to the greater quality of the best ones collected (e.g., Boudreau et al., 2011; Sanjiv, 2017; Terwiesch and Xu, 2008), and/or by processing such high quality ideas to innovate and ultimately apply them for commercial ends. More specifically, we argue that two firm-specific factors are crucial for extracting value from the crowd: *brand value* – which drives the number of potential contributions, thus increasing the likelihood of obtaining 'extreme outcomes' (Boudreau et al., 2011), i.e., high quality ideas with exceptional business potential, and *investment opportunities* – which increase the likelihood that a firm effectively processes such extreme outcomes from the crowd and turns them into profitable innovations. Consistent with our arguments, we find that the effect of crowdsourcing announcements on firm stock market performance is positively affected by higher brand value and higher investment opportunities.

This study makes a number of important contributions to the literature. First, we contribute to crowdsourcing research (Afuah and Tucci, 2012; Bayus, 2013; Blohm et al., 2013; Ford et al., 2015; Garcia Martinez, 2015; Penin and Burger-Helmchen, 2011; Poetz and Schreier, 2012; Schemmann et al., 2016) by analyzing the impact of crowdsourcing on firms' future profits and challenging the common view that engaging in crowdsourcing is always beneficial for a firm (Rass et al., 2013; Xu et al., 2015; Zhao and Zhu, 2012). Moreover, by providing empirical evidence of the boundary conditions under which crowdsourcing positively affects firm stock market performance, we not only advance the crowdsourcing literature, but also provide practitioners with indications on whether and when to launch crowdsourcing campaigns that have a positive impact on their firm's performance. Put differently, our findings show that not all firms may profit from crowdsourcing, pointing to the importance of taking into account the firm-specific factors that turn the external crowd into a valuable resource for the firm.

Second, as crowdsourcing is commonly seen as a particular form of OI, our findings respond to recent calls to outline the boundary conditions that make OI beneficial for firms' performance (Bogers et al., 2017; Chesbrough, 2012). By showing that two firm-specific contingency factors influence the effect of crowdsourcing on firm performance, this study sheds light on the importance of a contingency approach to identify the boundary conditions of the performance implications of different forms of OI, helping to reconcile the mixed findings from prior OI research (Bogers et al., 2017; Caputo et al., 2016).

Finally, while stock market reactions have been used in the context of internal R&D efforts (Mc Namara and Baden-Fuller, 2007; Narayanan et al., 2000), our market-based measure has not yet be applied in the OI field. With this event study, we advance current understanding of how forward-looking market-based measures, such as stock market reactions, can be used to analyze the long-term performance effects of OI activities, complementing alternative measures, such as the short-term performance and survey-based indicators commonly adopted in the OI literature (Ahn et al., 2015; Caputo et al., 2016; Cirillo and Valentini, 2014; Noh, 2015; Xu et al., 2015), thereby paving the way for a more comprehensive examination of the actual impact of OI on a firm's future profits.

2. Background and Hypotheses

OI can be classified into three categories, depending on the direction of the information flows (Dahlander and Gann, 2010; Enkel et al., 2009; Michelino et al., 2014; West and Bogers, 2014): (i) outside-in, where the firms' innovativeness benefits from ideas from outside the firm's boundaries; (ii) inside-out, which implies transferring internal ideas outside the firm's boundaries; and (iii) coupled, where both outside-in and inside-out flows exist. Crowdsourcing is an outside-in form of OI that firms use to enhance their innovation potential by leveraging fragmented knowledge that is dispersed over the crowd (Ghezzi et al., 2017). As we discuss in more detail below, while other forms of OI involve entities such as

other firms (e.g., suppliers, competitors) or universities, crowdsourcing specifically focuses on involving a larger number of widespread individuals external to the firm's boundaries, with unique traits in terms of legal rights on the innovation outcomes developed. Following Penin and Burger-Helmchen (2011), depending on the specific goal that the organization aims to achieve, it is possible to distinguish between three types of crowdsourcing: 'crowdsourcing of routine activities', 'crowdsourcing of content', and 'crowdsourcing of inventive activities'.

Crowdsourcing of routine activities refers to the externalization of low value-added repetitive activities for which no specific competences or heterogeneity (e.g., in terms of education, geographic location, experience) are needed from the crowd (an example is Internet Eyes that asks individuals to watch security camera feeds to spot potential crimes). Crowdsourcing of content uses the crowd to feed large amounts of data for which no specific knowledge is required, but the heterogeneity of individuals in the crowd is crucial (an example is OpenStreetMap that creates accessible geographic information through the contributions of different types of geographically dispersed individuals). Crowdsourcing of inventive activities leverages the competences and heterogeneity of the crowd to propose solutions to complex problems that the firm is unable to cope with using only its internal resources (an example is Samsung's Makers Against Drought campaign through which the firm asked the crowd to ideate solutions based on the internet-of-things technology to alleviate the frequent water crises in California). In this paper, we specifically focus on the latter, since it is most related to innovation processes and has the highest potential for firms in terms of new products introduced to the market and their associated profitability.

In parallel with the increasing use of crowdsourcing, whose participants doubled each year between 2006 and 2012 reaching 7 million (Angus, 2012), research in this field resulted in almost 1000 publications in Scopus from 2006 to 2015 (Ghezzi et al., 2017). One of the main

reasons for this growing interest in crowdsourcing is its potential to foster innovation through several valuable ideas from outside the firm's boundaries. Indeed, the involvement of a large number of individuals with different competences, backgrounds, and experiences allows firms to enhance their innovating capabilities, particularly in the early stage of an innovation process, i.e., the idea generation stage, since the broader the set of available ideas, the more likely the firm's ability to innovate (Björk and Magnusson, 2009; Ebner et al., 2009; van den Ende et al., 2015; Wilson et al., 2017). By tapping into this 'crowd wisdom', firms link disconnected external sources of knowledge with their internal resources to foster innovation (Surowiecki, 2005; Walsh et al., 2016). Through leveraging a vast array of skills and expertise, the involvement of a large crowd increases the likelihood of collecting extreme outcomes, which are ideas with exceptionally high business potential (Boudreau et al., 2011). As the conceptual study of Afuah and Tucci (2012) points out, crowdsourcing allows overcoming the firm's bounded rationality in innovating, solving problems by leveraging the crowd wisdom that turns what is otherwise distant search for the firm into easier local search for some individuals.

The crowdsourcing literature has so far analyzed crowdsourcing taxonomies (Estellés-Arolas and González-Ladrón-de-Guevara, 2012), the types of contributions people are more prone to propose in a crowdsourcing campaign (Ghezzi et al., 2017; Penin and Burger-Helmchen, 2011), the quality of crowdsourcing contributions (Poetz and Schreier, 2012), the motivations that lead people to participate (Acar et al., 2015; Garcia Martinez, 2015, 2017; Tokarchuk et al., 2012), and the best practices to manage crowdsourcing campaigns (Feller et al., 2012; Hewig, 2013; Kulkarni et al., 2012; Vuurens and De Vries, 2012). However, except for the aforementioned exploratory study of Xu et al. (2015) investigating the effect of crowdsourcing on Chinese firms' performance in relation to their competitors as perceived by the survey respondents, we lack knowledge on the impact of crowdsourcing on a firm's

future profits. This is particularly regrettable for at least two reasons: first, the mixed results from prior research on the impact of other forms of OI on firm operating and financial performance (Ahn et al., 2015; Bogers et al., 2017; Caputo et al., 2016; Cirillo and Valentini, 2014; Noh, 2015; Xu et al., 2015) cannot be directly extended to crowdsourcing due to its idiosyncrasies with respect to other forms of OI; second, without such knowledge, organizational decision makers are unable to understand whether and under what conditions crowdsourcing is beneficial or not for the firm.

In particular, crowdsourcing involves a larger number of dispersed individuals than the number of entities (such as universities, suppliers, or competitors) that are typically involved in other forms of OI. In this respect, managing the call for ideas, and identifying and implementing the best valuable ideas collected in a crowdsourcing campaign, differs from managing the activities when involving a more limited number of entities. For this reason, crowdsourcing campaigns entail particular costs and resources for firms. Indeed, firms must design, launch, and manage the call for ideas by developing and promoting a web-based platform to reach a large audience (Afuah and Tucci, 2012). Furthermore, the huge amount of contributions received must be critically analyzed and evaluated by experts within the firm to identify the most promising ones. These activities are time consuming and resource intensive for firms, and must be carried out carefully to collect the best possible ideas (Blohm et al., 2013).

In addition, crowdsourcing differs from other forms of OI in terms of ease of appropriability of innovations. The main outcome of R&D efforts is patents, which assign intellectual property rights to the holders to ensure that the innovations developed will not be copied (Hagedoorn et al., 2003). OI outcomes typically result in joint patents, which imply the co-ownership of intellectual property, whose exploitation is difficult and risky (Belderbos et al., 2014; Laursen and Salter, 2014). In fact, although the advantages of OI efforts led to

the proliferation of joint patents in the early 2000s (Hagedoorn et al., 2003), their effect on firms' future profits is debated in the literature, since by binding two parties in a trust relationship, they may limit future innovation advancements and patent self-citations (Belderbos et al., 2010; Caputo et al., 2016; Kim and Song, 2007). This problem is linked to the 'paradox of openness' (Laursen and Salter, 2014; Pollok et al., 2018), which stresses the importance of openness to create innovation, but also the relevance of tools to enhance the appropriability of innovations by means of intellectual property protection. According to Malerba (2002: 252), "Appropriability of innovations summarizes the possibilities of protecting innovations from imitation and of reaping profits from innovative activities". The more firms collaborate with external partners, the more they will have difficulty in appropriating the outcomes of these joint efforts (Belderbos et al., 2014). Instead, in crowdsourcing projects, individuals contribute in exchange for a possible reward, and surrender any right to further develop and exploit their contributions (Boudreau and Lakhani, 2015; Mortara et al., 2013). In this way, crowdsourcing allows firms to enjoy the benefits of OI without incurring appropriability issues.

There are therefore important conceptual reasons to distinguish crowdsourcing from other forms of OI, and the impact of crowdsourcing on firms' future profits is a relevant aspect that still needs to be duly examined.

Moreover, while crowdsourcing aims at boosting R&D activities, which are antecedents of innovation outputs (Raymond and St-Pierre, 2010), prior findings on the impact of internal R&D efforts on firms' future profits (Mc Namara and Baden-Fuller, 2007; Narayanan et al., 2000) cannot be directly extended to crowdsourcing, which is characterized by a higher level of uncertainty compared to internal R&D. In fact, while traditional R&D activities are conducted within the firm's boundaries, crowdsourcing entails a crowd of unknown individuals from outside the organization whose ideas have to be evaluated and ultimately

processed internally. Thus, while announcements of internal R&D efforts are generally considered a good antecedent of firms' future profits (Hall and Oriani, 2006; Mc Namara and Baden-Fuller, 2007; Narayanan et al., 2000), crowdsourcing entails more uncertainty, which we argue will be beneficial to firm performance only under certain conditions.

We apply the resource-based view (Barney, 1991; Wernerfelt, 1984) in this study as our theoretical lens to understand when crowdsourcing allows a firm to extract value, i.e., create and capture value (Chesbrough, 2003; Lepak et al., 2007; Randhawa et al., 2016), from the crowd, considered a distinctive resource outside the firm's boundaries. To assess which firm-specific factors enable the crowd to become a valuable resource, benefiting a firm's future profits, we analyzed stock market reactions to crowdsourcing announcements, i.e., firm stock market performance. Since the effect of crowdsourcing, which implies distant search that takes time to implement, can manifest in the long run, we rely on this forward-looking market-based measure grounded in signaling theory (Connelly et al., 2010; Spence, 1973) and the assumption that stock markets are efficient in evaluating information affecting a firm's future profits (Fama, 1970). While stock market reactions to announcements have been used in prior studies to assess the impact of firms' decisions on their future profits (Faccio and Stolin, 2006; Koh and Venkatraman, 1991; Mc Namara and Baden-Fuller, 2007), this measure has not been applied to examine the performance implications of OI and crowdsourcing. The aim of this study is therefore to analyze stock market reactions to crowdsourcing announcements to determine the contingent firm-specific factors that allow a firm to extract value from the crowd.

We contend that firms can extract value from the crowd by (i) collecting high quality ideas, and (ii) effectively processing such ideas for commercial purposes. First, value extraction is affected by the number of people responding to the call for ideas. Indeed, in a complex context such as innovating by involving a crowd, there is a relation between the

number of ideas received and the quality of extreme outcomes (Boudreau et al., 2011). This argument is in line with the reasoning that what is distant search for the firm may become local search for some crowdsourcing participants (Afuah and Tucci, 2012). Thus, the higher the number of people contributing to the crowdsourcing campaign, the greater the probability that the firm will identify some extreme outcomes among the thousands of proposals collected. Such extreme outcomes are exceptionally valuable ideas that a company can use to innovate, and are the ultimate goal of a crowdsourcing campaign (Boudreau et al., 2011). The amount (and hence the quality) of ideas collected depends on the size of the virtual brand community formed by individuals passionate about a company who gather online to discuss its products/service and activities (Djelassi and Decoopman, 2013; Wu and Fang, 2010). The participants in a virtual brand community are loyal and engaged customers mainly motivated to join the campaign by the prospect that their ideas will be developed and used by the firm whose brand they identify with and are loyal to (Smith and Shah, 2013; Wu and Fang, 2010). Put differently, as loyal customers, virtual brand community participants are highly committed to taking part in the call for ideas and to promote crowdsourcing through word-of-mouth referrals (Füller et al., 2013; Jensen and Hansen, 2006; Wu and Fang, 2010). They are also highly engaged in firm initiatives, such as crowdsourcing, as they will likely personally use the innovations developed (Smith and Shah, 2013; Wu and Fang, 2010). Thus, the number of engaged customers participating in a virtual brand community is a major source of contributions in a crowdsourcing campaign. The size of the virtual brand community is linked to a firm's brand value (Rosenthal and Brito, 2017), which proxies the customers' overall experience with the firm and the extent to which they gather around it (Farris et al., 2010; Iglesias et al., 2013; Simon and Sullivan, 1993).

Consequently, it is reasonable to expect that the higher a firm's brand value, the higher the number of customers passionate about the firm's activities who form the virtual brand

community, and therefore the higher the participation in the firm's call for ideas (Budac and Baltador, 2013; Fazal-e-Hasan et al., 2018; Füller et al., 2013; Rosenthal and Brito, 2017). Thus, we argue that firms with higher brand value will be able to mobilize a larger audience, collect more ideas, and thus have a greater probability of achieving extreme outcomes through crowdsourcing. In this way, the firm will be able to extract value from the crowd, which will ultimately be reflected in the stock market performance associated with the crowdsourcing announcement. This reasoning leads us to hypothesize:

Hypothesis 1: The impact of crowdsourcing on firm stock market performance is positively affected by a firm's brand value.

Collecting high quality ideas that lead to achieving extreme outcomes from among the multitude of ideas received is not the only condition for a firm to be able to extract value from the crowd. The ability to extract value from the crowd also depends on the firm's opportunity to effectively process such extreme outcomes to innovate and ultimately apply them to commercial ends (Lepak et al., 2007; Ritala and Hurmelinna-Laukkanen, 2009). This means that the firm needs to develop and successfully process the extreme outcomes collected (i.e., high quality ideas with exceptional business potential) in domains that are distant from its established knowledge domain. Indeed, the value of crowdsourcing resides in the firm's ability to profitably process the extreme outcomes collected from dispersed individuals who transform what was distant search for the company into a local search for some individuals (Afuah and Tucci, 2012). To this end, the firm's investment opportunity set is crucial, which Smith and Watts (1992: 224) define as "prospective investment opportunities and associated payoff distributions" related to a firm's physical and human capital investments. Investment opportunities are, therefore, firm-specific and include the

discretionary investments in innovation activities needed to transform an innovation idea into a new product/service, and increase the firm's profits (Gaver and Gaver, 1993).

Following this line of reasoning, we argue that firms with higher investment opportunities will have greater potential to process the extreme outcomes collected with the crowdsourcing campaign and thus more effectively extract value from the crowd. This finds support in the investment opportunities hypothesis stating that "R&D investments by firms with promising growth opportunities are generally worthwhile" (Szewczyk et al., 1996: 1), emphasizing their importance for a firm to benefit from the innovations developed. As crowdsourcing deals with distant search for the firm, which requires processing innovation ideas in domains distant from the current domain, and whose benefits for the firm's future profits will manifest in the long-run (Lepak et al., 2007; Ritala and Hurmelinna-Laukkanen, 2009), we argue that investment opportunities are even crucial for processing such ideas and developing profitable innovations. Thus, higher investment opportunities will increase the likelihood for firms to achieve profits from crowdsourcing.

In sum, we assume that extreme outcomes can be more effectively processed and applied to commercial ends for firms with higher investment opportunities, positively affecting the firm's future profits. Firms with higher investment opportunities are more effective in extracting value from the crowd, as they have higher physical and human capital (Gaver and Gaver, 1993) to process the ideas collected. By effectively processing such extreme outcomes, these firms are able to extract value from the crowd, which results in higher stock market performance associated with the crowdsourcing announcement. Formally stated:

Hypothesis 2: The impact of crowdsourcing on firm stock market performance is positively affected by a firm's investment opportunities.

3. Methods and Data

To assess the impact of crowdsourcing on a firm's future profits, we conducted an event study (Faccio and Stolin, 2006; Mc Namara and Baden-Fuller, 2007). This methodology rests on the assumption that capital markets are efficient (Fama, 1970), implying that publicly available information on firms is reflected in their stock market prices. Under this assumption, the firm's stock market capitalization may be considered a reasonable proxy of its underlying value, which changes only if new information affecting the firm's future profits is released. Thus, to assess the impact of crowdsourcing, we analyzed the stock market reactions to crowdsourcing announcements measured by the cumulative abnormal return (CAR), i.e., the stock market return in excess of the expected return in the days around the announcement (Liu et al., 2014).

Our data derive from Roth's (2015) database on crowdsourcing campaigns conducted over the last decade (2005-2015). This database reports all the major crowdsourcing campaigns launched online from which we isolated the crowdsourcing of inventive activities projects that are the focus of our study. Then, to conduct the event study, we isolated those crowdsourcing campaigns carried out by listed companies. We traced back their first public announcement date, if available, from the LexisNexis (www.lexisnexis.com) and Factiva (www.global.factiva.com) databases using the earliest date between the two records, resulting in a sample of 74 crowdsourcing projects. Table 1 reports the distribution of observations dispersed in terms of countries and industrial sectors. We retrieved the financial data (daily expected and effective returns to compute CAR, dividend yield, ROE, sales volume and industry sectors) using the Thomson Reuters Eikon software (release 2015). Brand value data derived from the Interbrand annual classification website (www.interbrand.com). The brand value variable reduced the final sample to 61 observations.

Details on the dependent, independent, and control variables are provided in the following subsections.

Table 1
Listed companies that announced crowdsourcing projects by country and industry.

SECTOR/COUNTRY	**USA**	**Europe**	**Asia**	***Total***
Consumer Cyclicals	6	3	5	13
Consumer Non-Cyclicals	2	2	0	4
Energy	0	2	0	2
Healthcare	1	4	0	5
Industrials	14	2	1	17
Technology	22	5	5	32
Total	45	19	12	74

3.1. Dependent variable

We used the cumulative abnormal returns (CARs) to capture abnormal stock price fluctuations induced by crowdsourcing announcements calculated as the sum of the daily abnormal returns (ARs), i.e., the ex-post returns of a security minus the expected return if the event had not taken place, over a period ranging from 10 days before to 10 days after the crowdsourcing announcement date. This timeframe is short enough to avoid the inclusion of potentially confounding effects, and long enough to account for information leaks and completely evaluate the announcement effects (Liao, 2014; McWilliams and Siegel, 1997). As a standard approach, we estimated expected daily returns through the market model using as the benchmark market the MSCI Index, an all-country index used as a gauge of world stock-market activities in event studies (Faccio and Stolin, 2006; Martynova and Renneboog, 2011). Considering data from -250 to -30 days relative to the announcement date, we estimated the coefficient β_i, which is the slope of the linear regression between the firms' returns and the MSCI index return. We then computed the daily ARs as the difference between observed returns and estimated returns, i.e., if the announcement had not occurred, as:

$$AR_i = R_i - (\beta_i R_m)$$

where β_i is the sensitivity of stock *i* to market-wide risk factors, and R_m is the market return. We obtained the firms' CARs by summing the daily ARs in the timeframe identified as:

$$CAR = \sum_{-10}^{+10} AR_i$$

To check for the robustness of the results, we also used a different market benchmark, i.e., national stock markets related to the country of incorporation of each company, as reported in the Appendix.

3.2. Independent variables

3.2.1. Brand Value

Brand value captures the effect of a higher number of expected contributions collected with a crowdsourcing campaign, leading to better quality extreme outcomes and therefore higher value extracted from the crowd. Brand value is the capitalized value of the profits that result from associating that firm's brand name with specific products and services (Simon and Sullivan, 1993). In particular, we measured the value of brands involved in crowdsourcing campaigns through the firms' ranking in the Interbrand annual brand classification, a widely used annual report of the top 100 brands worldwide (Chu and Keh, 2006; Farris et al., 2010; Kamakura and Russell, 1993). This ranking is based on the impact that brands have on increasing firm profits (Chaudhuri and Hoibrook, 2001; Füller et al., 2013). In the Interbrand ranking, rank 1 represents the highest brand value and rank 100 the lowest.

3.2.2. Investment opportunities

According to pecking order theory (Collins et al., 1994; Myers, 1984), a firm's priority is investing the cash generated in new investment opportunities, rather than distributing it in the form of dividends (Frank and Goyal, 2003; Huang and Paul, 2017; Myers and Majluf, 1984). Based on this premise, firms can be classified according to growth stocks and income stocks (Aghion and Stein, 2008; Benner, 2007; Bradshaw, 2004): the latter are expected to remunerate shareholders with dividends, the former are expected to grant shareholders higher returns by focusing on investments for long-term growth, such as those needed to process and turn the extreme outcomes collected through crowdsourcing into innovations, and are thus expected to pay low or no dividends to shareholders. For this reason, prior studies find that when firms have higher investment opportunities, they will pay lower dividends to shareholders (Abor and Bokpin, 2010; Brav et al., 2005; Gaver and Gaver, 1993; Renneboog and Trojanowski, 2011; Smith and Watts, 1992; Yoon and Starks, 1995). Therefore, following prior empirical studies (e.g., Denis, 1994; Kallapur and Trombley, 1999), we operationalize investment opportunities with the dividend yield, i.e., the ratio between the dividends paid and the firm's stock price. In particular, a higher dividend yield signals fewer investment opportunities. Our Hypothesis 2, therefore, implies a negative coefficient for dividend yield.

3.3. Control variables

To test our hypotheses, we controlled for five variables that may affect the relationship between crowdsourcing announcements and stock price reactions: firm openness, firm size, firm profitability, financial crisis, and the firm's industrial sector. As crowdsourcing is a particular form of OI, we controlled for the current level of firms' openness, measured as the number of joint patents over the number of fully owned patents (Belderbos et al., 2014). We retrieved patent information from the European Patent Office through the PATSTAT

platform (Spring 2016 version). Moreover, due to the positive effects of economies of scale, quality of employees, and commercialization capabilities, a firm's size might affect its ability to profit from innovation efforts (Hitt et al., 1991). For this reason, we controlled for firm size, measured by yearly sales. In addition, we controlled for firm profitability (captured by return on equity), and for the effects of the 2008 financial crisis (measured by a dummy variable that equals 1 if the crowdsourcing campaign was launched between 2008 and 2010, and 0 otherwise) to isolate other possible confounding effects on stock market performance (Noh, 2015). Finally, we controlled for industrial sector, since some perform better than others in securing the appropriability of innovations (in terms of the effectiveness of intellectual property rights protection, time to market, and nature of the innovation), which facilitates firms in achieving profits (Hurmelinna-Laukkanen and Puumalainen, 2007). We used five dummy variables for the technological, cyclical, non-cyclical, industrial, healthcare, and energy sectors. The healthcare sector is taken as reference point due to the higher level of appropriability of innovations (Cohen et al., 2000).

4. Results

The normality test we conducted confirmed the Gaussian distribution of the sample required for the event study methodology. We report the descriptive statistics and correlations among variables in Table 2, evidencing that multicollinearity is not a problem in the sample. Table 3 reports the results of the OLS models: Model 1 includes only the control variables, Models 2 and 3 show one independent variable at a time (respectively brand value and dividend yield), and Model 4 comprises both the independent and control variables.

Table 2
Descriptive statistics and correlations (CAR, Brand value, Dividend yield, Return on Equity, Sales, Year crisis, Joint patents and Sector Dummies).

	Mean (STD)	**CAR**	**Div. Y.**	**Brand V.**	**ROE**	**Sales**	**Year c.**	**J. pat.**	**Techn. s.**	**Cycl. s.**	**Non-Cycl. s.**	**Ind. s.**	**Health. s.**	**Ener. s.**
CAR	0.011 (0.065)	1												
Brand value	26.29 (26.08)	-0.02	1											
Dividend yield	0.025 (0.017)	-0.24	-0.04	1										
ROE	0.791 (4.471)	-0.17	-0.02	-0.11	1									
Sales	$9.68e^{12}$ ($4.00e^{13}$)	-0.01	-0.18	-0.13	0.45	1								
Year crisis	0.162 (0.371)	-0.09	-0.18	-0.20	-0.07	-0.11	1							
Joint patents ratio	0.710 (1.137)	0.11	-0.37	0.05	-0.11	-0.11	0.49	1						
Technological sector dummy	0.432 (0.498)	-0.07	-0.54	-0.31	0.06	0.24	0.35	0.27	1					
Cyclical sector dummy	0.189 (0.394)	0.14	-0.03	0.46	-0.06	-0.05	-0.23	0.01	-0.43	1				
Non-cyclical sector dummy	0.054 (0.227)	-0.09	0.05	0.05	0.03	-0.06	0.10	0.01	-0.18	-0.11	1			
Industrial sector dummy	0.229 (0.423)	-0.04	0.37	-0.26	0.05	-0.15	-0.15	-0.23	-0.47	-0.29	-0.12	1		
Health care sector dummy	0.067 (0.252)	0.04	0.24	0.14	-0.06	-0.07	-0.11	-0.18	-0.22	-0.13	-0.06	0.15	1	
Energy sector dummy	0.027 (0.163)	0.04	0.41	0.23	-0.02	-0.03	-0.05	0.04	-0.10	-0.06	-0.02	-0.07	-0.03	1

Table 3
OLS regression.

Number of observations	**74**	**61**	**74**	**61**
***p*-value Fisher test**	0.88	0.71	0.17	0.06
R^2	0.06	0.12	0.18	0.29
Adjusted R^2	-0.06	-0.05	0.06	0.13
	Model 1	**Model 2**	**Model 3**	**Model 4**
Brand value		-0.001		-0.001**
		(0.000)		(0.000)
Dividend yield			-1.611***	-2.822***
			(0.036)	(0.831)
ROE	-0.001	-0.007	-0.001	-0.006
	(0.002)	(0.004)	(0.001)	(0.000)
Sales	$3.38\ e^{-17}$	$1.59e^{-16}$	$-5.49e^{-17}$	$4.40e^{-17}$
	(0.000)	(0.000)	(0.000)	(0.000)
Year crisis	-0.027	-0.029	-0.029	-0.018
	(0.023)	(0.028)	(0.007)	(0.025)
Joint patents %	-0.002	0.020	-0.004	0.005
	(0.007)	(0.014)	(0.036)	(0.014)
Technological sector dummy	-0.005	-0.033	-0.034	-0.097**
	(0.034)	(0.038)	(0.033)	(0.039)
Cyclical sector dummy	0.013	0.001	-0.011	-0.026
	(0.035)	(0.038)	(0.034)	(0.035)
Non-cyclical sector dummy	-0.007	-0.040	-0.026	-0.067
	(0.049)	(0.050)	(0.047)	(0.046)
Industrial sector dummy	0.009	-0.026	-0.010	-0.046
	(0.034)	(0.038)	(0.032)	(0.035)
Health care sector dummy	Dropped	Dropped	Dropped	Dropped
Energy sector dummy	-0.025	-0.015	0.009	0.136*
	(0.056)	(0.074)	(0.054)	(0.076)
Intercept	0.019	0.045	0.083**	0.165***
	(0.030)	(0.036)	(0.035)	(0.048)

CAR is the dependent variable, Brand Value and Dividend Yield are the independent variables, and the remainder are control variables. Benchmark market is the MSCI Index. Model 1 includes only control variables, Models 2 and 3 contain one independent variable at a time, and Model 4 comprises both the independent variables. Standard errors are reported in brackets (* stands for $p<0.10$; ** stands for $p<0.05$; *** stands for $p<0.01$).

Focusing on the full model, i.e., Model 4, the effect of brand value on CAR is negative and significant (*p*-value <0.02). This result is consistent with our argument that higher brand value attracts more submissions in a crowdsourcing campaign, a circumstance that positively affects the collection of high quality ideas with exceptional business potential, i.e., extreme outcomes, in turn positively affecting stock market performance. Therefore, Hypothesis 1 is supported. In addition, we found a negative and significant (*p*-value <0.01) effect of the dividend yield variable on CAR. This result is consistent with our prediction that firms with higher investment opportunities, i.e., those paying lower dividends, are more effective in

processing the extreme outcomes collected from the crowd for commercial purposes, which results in higher future profits from crowdsourcing. Thus, Hypothesis 2 is also supported. Also worth noting is that the effects of the independent variables determine the sign of the overall stock market reaction to crowdsourcing announcements, thus evidencing when crowdsourcing increases a firm's future profits. The robustness check we performed with national stock markets relative to each crowdsourcing announcement as the benchmark market instead of the MSCI index confirms the results of the study, as reported in the Appendix.

Looking further into our results, we note some other insights deriving from the control variables. First, the crowdsourcing announcements are better received by stock markets when firms operate in the energy sector. This effect may be due to the growing attention toward environmentally related innovations (Bointner, 2014). In fact, energy sector innovations increasingly attract managerial and policymakers' interest in that energy waste reduction and renewables technologies are particularly profitable investments that benefit the whole society (Obama, 2017). Moreover, the energy sector offers greater appropriability of innovations with respect to other sectors, and due to the fact that patenting is time-consuming, its effectiveness as an appropriability mechanism can be higher in sectors such as this, which are not developing at a fast rate (Hurmelinna-Laukkanen and Puumalainen, 2007). As energy sector innovations take time to develop and implement (Sagar and van der Zwaan, 2006), the imitation of such innovations can be more difficult and protracted for rivals, thus benefiting the innovating firm's profits to a greater extent. In addition, our results also indicate that crowdsourcing announcements have a negative effect in the technological sector. In contrast to the energy sector, this sector is fast changing, which limits the advantages of intellectual property protection (Hurmelinna-Laukkanen and Puumalainen, 2007). Moreover, the technology sector sees increasingly frequent lawsuits for patent infringements (Lumann and

Dodson, 2006; Pohlmann and Opitz, 2013), making appropriability of innovations for firms more difficult to achieve.

5. Discussion

Crowdsourcing is a recent form of outside-in OI used to access the fragmented knowledge of dispersed individuals (Afuah and Tucci, 2012; Garcia Martinez and Walton, 2014; Surowiecki, 2005). Although the crowdsourcing phenomenon has been the focus of a growing body of research, the literature is ambiguous as to whether and when crowdsourcing benefits firms' performance. Understanding the performance implications of crowdsourcing is therefore an important question that remains unaddressed (Bogers et al., 2010). Our study of the population of crowdsourcing campaigns launched online by listed companies analyzes the impact of crowdsourcing on a firm's future profits, a topic that has only tentatively been examined in one previous study by means of perceived performance relative to competitors as self-reported through a survey (Xu et al., 2015). In our event study using a forward-looking market-based measure of firm performance for the first time, i.e., firm stock market performance, we theorize and test two important boundary conditions that lead to positive stock market reaction following the announcement of a crowdsourcing campaign. In so doing, we provide preliminary support for the claim that crowdsourcing is able to benefit a firm's future profits only under certain conditions (Afuah and Tucci, 2012; Ford et al., 2015; Garcia Martinez, 2015; Jeppesen and Lakhani, 2010; Poetz and Schreier, 2012; Schemmann et al., 2016).

We base our arguments on the theoretical lens of the resource-based view (Barney, 1991; Wernerfelt, 1984), deemed particularly suited to further our understanding of OI issues (Alexy et al., 2017; Randhawa et al., 2016; West and Bogers, 2017), albeit not applied in prior crowdsourcing studies. Drawing on this theoretical lens, we conceive the crowd as a distinctive external resource from which a firm can extract value through crowdsourcing. In

particular, we show that two firm-specific factors are crucial to extracting value from the crowd to benefit the firm's future profits. The first factor that allows extracting value from the crowd is brand value, as it drives the number of potential contributions collected through a crowdsourcing campaign, thus increasing the likelihood of obtaining extreme outcomes (Boudreau et al., 2011), i.e., high quality ideas with exceptional business potential. In fact, brand value is strongly linked with a loyal, active, and trusting customer base, enhancing the number of outcomes collected in crowdsourcing projects (Iglesias et al., 2013; Rosenthal and Brito, 2017). This finding is consistent with the crowdsourcing definition that Sheehan (2010: 105) proposed, highlighting the centrality of the brand, whereby crowdsourcing is "the ability to gather a large group of people around your brand and get them working to develop products and/or solutions". The second factor that allows a firm to extract value from the crowd is investment opportunities through specific investments in physical and human capital (Gaver and Gaver, 1993), as this enables effectively processing the extreme outcomes collected through crowdsourcing. This view is consistent with the OI literature arguing the importance of processing new ideas and applying them to commercial ends to achieve a competitive advantage and sustain firm performance (e.g., Chesbrough, 2003; Ireland et al., 2002; Randhawa et al., 2016). Indeed, firms need to effectively develop the ideas collected and apply them to commercial ends to achieve a competitive advantage and increase their profits. In line with the investment opportunity hypothesis of Szewczyk et al. (1996), underlining the link between profitable R&D activities and investment opportunities, our findings show that investment opportunities are even crucial for crowdsourcing. In fact, by seeking cutting-edge ideas from dispersed individuals, crowdsourcing entails distant search for the firm (Afuah and Tucci, 2012), as the ideas collected from the crowd derive from domains distant from those generally within the firm's boundaries, and the benefits of processing them into commercial ends manifest in the long run. Due to the long-term growth

focus and the physical and human capital investments required to deal with innovations developed in other domains, firms need high investment opportunities to effectively process the innovation developed, and thereby increase profits.

Thus, brand value and investment opportunities determine to what extent firms are able to extract value from the crowd, ultimately benefiting their future profits. In the following, we summarize and discuss the theoretical and empirical contributions of this study and the implication of our work for future research, managerial practice, and policy-making.

5.1. Contributions

Our study contributes to the literature in three important ways. First, we add to the proliferating crowdsourcing research stream (Ford et al., 2015; Garcia Martinez, 2015; Poetz and Schreier, 2012; Pollok et al., 2018; Schemmann et al., 2016). Prior studies are mainly conceptual in analyzing the benefits of crowdsourcing (e.g., Afuah and Tucci, 2012, 2013; Bloodgood, 2013), assuming its unconditional benefits for a firm (e.g., Rass et al., 2013; Xu et al., 2015; Zhao and Zhu, 2012), but without conducting an objective, in-depth examination of the implications of crowdsourcing on a firm's future profits. We advance this literature by developing a richer understanding of when firms may actually benefit from crowdsourcing. We do so by analyzing the impact of crowdsourcing on a firm's future profits and clarifying the performance implications associated with this phenomenon.

By showing that not all firms may profit from crowdsourcing, and highlighting the importance of taking into account the firm-specific factors that turn the external crowd into a valuable resource for the firm, our findings suggest that crowdsourcing is not always beneficial, as posited in prior research (Rass et al., 2013; Xu et al., 2015; Zhao and Zhu, 2012). Instead, our study suggests that the effect of crowdsourcing on a firm's future profits depends on brand value and investment opportunities, thus contributing a more complete

understanding of the conditions under which a firm can extract value from the crowd with a crowdsourcing campaign.

Second, this study provides the basis for a new approach to examining performance associated with different forms of OI. By focusing on crowdsourcing as a particular form of OI, we respond to recent calls for defining the boundary conditions that make OI beneficial for firms' performance (Bogers et al., 2017; Chesbrough, 2012). Examining how two firm-specific factors influence the impact of crowdsourcing on a firm's profits, the contingency approach we propose enables more precise theoretical predictions of the impact of different forms of OI. Identifying the boundary conditions of the performance implications of different forms of OI helps reconcile the mixed findings in prior OI research (Bogers et al., 2017; Caputo et al., 2016). Although the OI phenomenon has been extensively studied and widely used in corporate practice (Bogers et al., 2017; Gassmann et al., 2010), understanding the boundary conditions of the impact of different forms of OI on a firm's future profits is crucial to developing a comprehensive theory of OI (Busse et al., 2017), which is still lacking. In this respect, our article contributes insights that extend current understanding of OI.

Third, by analyzing stock market performance to assess the benefits of crowdsourcing and introducing an important methodological refinement, our study provides a more fine-grained assessment of the impact of crowdsourcing on firms' future profits. While the methodology based on stock market reactions has been used to assess performance implications in the context of internal R&D efforts (Mc Namara and Baden-Fuller, 2007; Narayanan et al., 2000), prior studies assessing firms' benefits from OI and crowdsourcing rely mainly on surveys or short-term financial performance indicators (Ahn et al., 2015; Bogers et al., 2017; Caputo et al., 2016; Noh, 2015; Rass et al., 2013; Xu et al., 2015). Instead, we employ a market-based approach that allows isolating the long-term effects of crowdsourcing on firms' future profits. Indeed, based on signaling theory (Spence, 1973) and the efficiency of stock

markets (Fama, 1970), the effects of the announcement of a crowdsourcing campaign are immediately reflected in the stock price (Connelly et al., 2010; Spence, 1974), an approach measuring the impact on a firm's future profits that has thus far not been applied in the OI field. Our event study therefore advances current understanding of how forward-looking market-based measures, such as stock market reactions, can be employed to analyze the long-term performance effects of OI activities, complementing the alternative measures, such as short-term performance and survey-based indicators, commonly adopted in the OI literature (Ahn et al., 2015; Bogers et al., 2017; Caputo et al., 2016; Cirillo and Valentini, 2014; Noh, 2015; Rass et al., 2013; Xu et al., 2015).

5.2. Implications for practice and policy making

Our study points to important implications for crowdsourcing practice. We forewarn practitioners that not all firms may profit from crowdsourcing, and caution those involved in crowdsourcing activities against launching crowdsourcing campaigns without carefully assessing the possible consequences of such campaigns on their firm's future profits. Our results provide practitioners with indications on whether and when to launch crowdsourcing campaigns that have a positive impact on their firm's future profits, and emphasize the importance for practitioners to consider two firm-specific factors that lead to the external crowd becoming a valuable resource for the firm. Thus, our results provide practitioners with relevant indications for launching successful crowdsourcing campaigns.

Moreover, guidance from this research may be particularly useful to policymakers. Crowdsourcing initiatives are increasingly garnering attention in the public domain and mass media (Ferrari and Fidanboylu, 2013; Houlihan and Harvey, 2018; Tucker, 2017), and can be a crucial driver of firm innovation and growth (Angus, 2012; Bayus, 2013; Poetz and Schreier, 2012; Schemmann et al., 2016), a key goal on the agenda of policy makers. Our research advocates a better understanding of how to build a system of support initiatives to

innovation in line with the firm-specific factors that shape the future profits a firm can obtain through crowdsourcing, aiding policy makers in their decisions on how to promote profitable crowdsourcing initiatives.

5.3. Limitations and opportunities for future research

Our analysis is not exempt from limitations that future research should take into account. First, the crowdsourcing projects in our sample relate to listed companies, which may have implications for the circumstances under which a crowdsourcing campaign impacts future profits. For instance, listed companies may be endowed with higher financial and human resources and/or different discretion to use such resources compared to private firms (Acharya and Zhaoxia, 2017; Durand and Vargas, 2003), suggesting that the firm's ability to extract value from the crowd through crowdsourcing may vary according to the ownership and/or governance structure. Thus, we encourage scholars to conduct future studies aimed at understanding how crowdsourcing and its effects on firm performance may differ in form and significance among firms with different types of ownership and governance (e.g., privately held firms, cooperative ventures, joint ventures, family firms, venture capital-backed firms, state-owned firms, non-profits, research institutions).

Second, our study focuses on crowdsourcing of inventive activities, without considering other types of crowdsourcing, such as crowdsourcing of routine activities or crowdsourcing of content (Penin and Burger-Helmchen, 2011). Nonetheless, future research focusing on different types of crowdsourcing could extend our work in important ways, for example, examining how the outcomes and effectiveness of crowdsourcing campaigns vary according to the intended goals, as different types of crowdsourcing are driven by different goals. In addition, we do not take into account potential heterogeneity among the crowd. Understanding how different types of individuals in the crowd may differently affect the

impact of a crowdsourcing campaign on firm performance is thus another area ripe for future research.

Third, although our study highlights when crowdsourcing benefits a firm's future profits, we do not consider how crowdsourcing activities should be managed at the micro level. Using a micro-foundational lens (Felin et al., 2015) to examine how the characteristics, behaviors, and interactions of individuals, and the practices they adopt affect the way crowdsourcing campaigns are launched and managed is another promising direction for future research.

Fourth, while we provide initial evidence of how the industrial sector might influence the impact of crowdsourcing on a firm's future profits, this relationship should be more deeply explored in future studies. We call for sector studies (De Massis et al., 2018) aimed at shedding further light on how the industrial sector shapes the organizational outcomes of crowdsourcing and the process through which the crowd interacts with the sector to propose ideas in response to a given problem – an aspect that remains largely under-theorized and little understood.

Finally, although our study is based on the population of 'crowdsourcing of inventive activities' campaigns that listed companies launched in the period under investigation, we encourage future scholars to collect larger samples to confirm and enrich our study's findings.

6. Conclusion

Crowdsourcing is increasingly adopted in corporate practice to boost innovation. Although the crowdsourcing literature has burgeoned in recent years, the effect of crowdsourcing on a firm's future profits is far from clear. Through an event study of stock market reactions to crowdsourcing announcements, we offer new insights on the conditions under which crowdsourcing can benefit a firm's stock market performance. Our findings indicate two key

contingency factors, i.e., brand value and investment opportunities, representing the conditions under which firms can extract value from the crowd, resulting in a positive effect of crowdsourcing on stock market performance. Taken together, these findings pave the way for future research on the performance implications of crowdsourcing, offering a new perspective on when crowdsourcing is beneficial for a firm's performance.

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Appendix

Table 4
OLS regression.

Number of observations	**74**	**61**	**74**	**61**
***p*-value Fisher test**	0.88	0.71	0.17	0.06
R^2	0.06	0.12	0.18	0.29
Adjusted R^2	-0.06	-0.05	0.06	0.13
	Model 1	**Model 2**	**Model 3**	**Model 4**
Brand value		-0.001		-0.001*
		(0.000)		(0.000)
Dividend yield			-1.243**	-2.295***
			(0.495)	(0.759)
ROE	-0.001	-0.006	-0.001	-0.006
	(0.002)	(0.004)	(0.001)	(0.004)
Sales	$1.55\ e^{-17}$	$1.49e^{-16}$	$-6.70e^{-17}$	$6.10e^{-17}$
	(0.000)	(0.000)	(0.000)	(0.000)
Year crisis	-0.046*	-0.041	-0.047**	-0.033
	(0.022)	(0.025)	(0.021)	(0.023)
Joint patents %	-0.001	0.023*	-0.002	0.010
	(0.001)	(0.013)	(0.006)	(0.012)
Technological sector dummy	0.006	-0.007	-0.016	-0.059*
	(0.032)	(0.034)	(0.032)	(0.036)
Cyclical sector dummy	0.001	0.007	-0.010	-0.014
	(0.033)	(0.034)	(0.033)	(0.032)
Non-cyclical sector dummy	-0.002	-0.022	-0.018	-0.044
	(0.046)	(0.045)	(0.045)	(0.042)
Industrial sector dummy	0.011	0.003	-0.002	-0.012
	(0.032)	(0.034)	(0.031)	(0.032)
Health care sector dummy	Dropped	Dropped	Dropped	Dropped
Energy sector dummy	-0.024	-0.019	0.002	0.116*
	(0.053)	(0.066)	(0.052)	(0.069)
Intercept	0.019	0.045	0.083*	0.113**
	(0.030)	(0.036)	(0.035)	(0.044)

Notes: CAR is the dependent variable, Brand Value and Dividend Yield are the independent variables, and the remainder are control variables. Benchmark market is National Stock Index for each company. Model 1 includes only control variables, Models 2 and 3 contain one independent variable at a time, and Model 4 comprises both the independent variables. Standard errors are reported in brackets (* stands for $p<0.10$; ** stands for $p<0.05$; *** stands for $p<0.01$)