Crowdfunding: Tapping the Right Crowd[*]

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February 13, 2011

Abstract

The paper first aims at identifying a number of stylized facts related to crowdfunding that are worth studying from an economic perspective. On the basis of a unique, hand-collected dataset, we isolate important features of crowdfunding. The second objective is to propose a model of crowdfunding that encompasses several of these key features. We derive a model that associates crowdfunding with pre-ordering and price discrimination, and we study the conditions under which crowdfunding is preferred to traditional forms of external funding. The model highlights the importance of community-based experience for crowdfunding to be a viable source. Also, it shows that crowdfunding is optimal only for lower levels of finance, since otherwise it leads to excessive price distortions between crowdfunders and other consumers.

JEL classification codes: G32, L11, L13, L15, L21, L31
Keywords: crowdfunding, price discrimination

1 Introduction

It is well recognized that new ventures face difficulties in attracting external finance at their very initial stage, be it through bank loans or equity capital (see, e.g., Cosh et al., 2005). While business angels and venture capital funds fill gaps for larger amounts, the smallest amounts are provided by entrepreneurs themselves and friends & family. Still, many ventures remain unfunded, partially because of a lack of sufficient value that can be pledged to investors, partially because of unsuccessful attempts to find and convince investors. Recently, creative founders have made use of a new source of finance – so-called *crowdfunding* – by tapping the "crowd" instead of specialized investors.

The concept of crowdfunding finds its root in the broader concept of *crowdsourcing*, which uses the crowd to obtain ideas, feedback and solutions in order to develop corporate activities. In the case of crowdfunding, the objective is to collect money for investment; this is generally done by using social networks, in particular through the Internet (Twitter, Facebook, LinkedIn and different other specialized blogs). In other words, instead of raising the money from a very small group of sophisticated investors, the idea of crowdfunding is to obtain it from a large audience (the "crowd"), where each individual will provide a very small amount.

In the music industry, crowdfunding platforms have emerged under labels such as *SellaBand*, *MyMajorCompany* or *Artistshare*. These platforms share the following business model: artists can post a number of songs on a website; visitors to the site can then listen to the music free and may choose artists they want to invest in; when artists reach a threshold pledge (e.g., $50,000 on *SellaBand*, while the crowd can purchase participation rights at the price of $10 each), the artist uses the money to produce and distribute the album; investors are either compensated by receiving a share of the revenues from the album (*SellaBand* and *MyMajorCompany*), or are rewarded by having privileged access to the creative process or by being credited on the album (*ArtistShare*). Although *SellaBand* (created in 2006) filed for bankruptcy in February 2010, other labels organized around this business model seem to thrive; for instance, the French songwriter Grégoire reached the Top 5 in France with his single 'Toi + Moi' after having been discovered and funded by the public through *MyMajorCompany*.

While crowdfunding has been primarily used in the entertainment indus-

try so far (especially music and movie), a few initiatives have been undertaken recently in other industries such as journalism (*Spot.Us*), beer (*Beer-Bankroll*), software (*Blender Foundation*, *Trampoline Systems*) and fashion (*Cameesa*).[1] The basic idea is always the same: instead of raising the money from a very small group of sophisticated investors, entrepreneurs try to obtain it from a large audience, where each individual will provide a very small amount. The amounts that have been targeted through crowdfunding have continuously increased, with *Trampoline Systems* targeting more than £ 1 million for the financing of the commercialization stage of their new software.

In this paper, we first discuss a definition of crowdfunding and several issues pertaining to the practice of crowdfunding in connection with entrepreneurial activities. Crowdfunding leads to complexities that are distinct from its overarching concept, namely crowdsourcing. Next, we derive characteristics of crowdfunding initiatives by means of unique, hand-collected data of 51 entrepreneurial initiatives. These data are helpful in providing a better understanding of how such initiatives are structured and what motivates them. Perhaps surprisingly, only a limited fraction of initiatives is based on donations. The major fraction are passive investments; i.e., investments with a promise of compensation but no direct involvement in the decision-making process or provision of time or expertise for the initiative. In most of the cases, the compensation is to receive a product or service from the financed activity, in which case the crowdfunding ressembles a distinct form of pre-ordering.[2] Shares are offered in one third of our sample only.

While the primary goal of crowdfunding is certainly to raise money, our contention in this paper is that there is more to crowdfunding than just funding. Because appeal is made to consumers and because Web 2.0 tools are used, crowdfunding may also help firms in testing, promoting and marketing their products, in gaining a better knowledge of their consumers' tastes, or in creating new products or services altogether. Therefore, all the recent entrepreneurial experiences in raising capital through crowdfunding raise new and interesting questions not only in the areas of corporate finance and entrepreneurship but also in the area of industrial organization.

To address some of these issues, we propose a model of crowdfunding

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[1] For a list of similar initiatives, visit http://crowdfunding.pbworks.com/ (last consulted on June 9, 2010).

[2] For instance, *BeerBankroll* gives tangible benefits such as a logo T-shirt, gift cards to popular retailers, and memorabilia.

that encompasses several of the key features identified in the empirical part. In particular, we develop a model that associates crowdfunding with pre-ordering and price discrimination, and we study the conditions under which crowdfunding is preferred to traditional forms of external funding (bank loan or equity investor). In this framework, the funding is needed to finance upfront fixed costs of production. Since the remaining consumers will pay a different price, crowdfunding that takes the form of pre-ordering gives the opportunity to price discriminate between the first group (those who pre-order and constitute thus the investing "crowd") and the second group (the other consumers who wait that production takes place before purchasing directly). However, a firm is generally unable to identify these consumers. The firm must then use some self-selecting device so as to induce high-paying consumers to reveal themselves. In this sense, crowdfunding appears as a form of menu pricing. The trade-off we explore in the model is thus the following: compared to external funding, crowdfunding has the advantage of offering an enhanced experience to some consumers and, thereby, of allowing the firm to practice second-degree price discrimination and extract a larger share of the consumer surplus; the disadvantage is that the firm is constrained in its first period price by the amount of capital it needs to raise: the larger this amount, the larger the pre-ordering price and the less profitable the menu pricing scheme. Importantly, the model highlights the importance of community-based experience for crowdfunding to be a viable alternative. Also, it shows that crowdfunding is optimal only for lower levels of finance. Indeed, as the amount required becomes larger, the entrepreneur is forced to distort more prices so that more consumers are willing to pre-order and thus the entrepreneur can collect upfront more money. This in turn reduces the gains from price-discrimination. Our results are robust to the possibility that the entrepreneur may take the money collected from the crowdfunding initiative and run away with the money.

The remaining of this paper is structured as follows. The next section offers a definition of crowdfunding, presents our empirical survey analysis, summarizes key features from the industrial organization point of view and provides a survey of related literature. Section 3 presents the theoretical model and discusses its results and implications. Section 4 presents a number of extensions of the model, while Section 5 concludes with suggested topics for future research.

2 A road map for studying crowdfunding

Our objective in this section is to answer the following two questions: (i) What is exactly crowdfunding? (ii) What are the particular aspects of crowdfunding that make it interesting to study from an industrial organization perspective? We also provide a review of the literature that can be relevant to study crowdfunding.

2.1 A definition of crowdfunding

As mentioned, the concept of crowdfunding can be seen as part of the broader concept of crowdsourcing, which uses the "crowd" to obtain ideas, feedback and solutions in order to develop corporate activities. The term "crowdsourcing" has been first used by Jeff Howe and Mark Robinson in the June 2006 issue of *Wired Magazine*, an American magazine for high technology.[3] Kleemann et al. (2008) point out that "crowdsourcing takes place when a profit oriented firm outsources specific tasks essential for the making or sale of its product to the general public (the crowd) in the form of an open call over the internet, with the intention of animating individuals to make a [voluntary] contribution to the firm's production process for free or for significantly less than that contribution is worth to the firm." Although this definition of crowdsourcing is a useful starting point, several caveats and clarifications need to be made in order to transpose it to crowdfunding. Hereafter, we offer a discussion on the application of this definition to crowdfunding; we ultimately provide key elements in understanding why crowdfunding is embedded in the definition of crowdsourcing.

Raising funds by tapping a general public (or the crowd) is the most important element of crowdfunding. This means that consumers can volunteer to provide input to the development of the product, in this case in form of financial help.[4] From this perspective, crowdfunding is a subset of crowdsourcing, since the latter encompasses also financial help. How the interaction with the crowd takes place may, however, differ. For instance,

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[3]For a non technical introduction of crowdsourcing, see Howe (2008).

[4]We note that an important motivation for relying on crowdsourcing is that it may contribute in reducing production costs (Kleemann et al., 2008). For instance, the pharmaceutical company *Innocentive* has organized its crowdsourcing practice in form of a tournament, where the provider of the best solution was rewarded with a prize (Albors et al., 2008).

several platforms have emerged recently, such as *Fundable*, *Kickstarter*, *Kiva*, *Sandawe*, and *SellaBand*. These intermediate between entrepreneurs and potential crowdfunders. Therefore, a distinction can be made between direct and indirect fundraising because at times entrepreneurs make use of such crowdfunding platforms instead of seeking direct contact with the crowd. These platforms at times share some similarities with online lending markets (Everett, 2008; Freedman and Jin, 2010); while the latter more prominently target social entrepreneurship, crowdfunding platforms have a broader scope of entrepreneurial initiatives.

As pointed out by Brabham (2008) and Kleemann et al. (2008), among others, the development of Web 2.0 is a critical ingredient that has facilitated the access to the "crowd". Roughly speaking, Web 2.0 is a Web-as-participation-platform that facilitates interaction between users.[5] This structure is crucial for entrepreneurs to be able to easily reach networks of investors or consumers, especially if the initiative does not take place through a platform.[6]

While the use of the Internet to make an "open call" may be very efficient for crowdsourcing in general, it can become more problematic for crowdfunding, especially if it involves the offering of equity to the crowd. Indeed, making a general solicitation for equity offering is limited to publicly listed equity. In many countries, there is also a limit as to how many private investors a company can have.[7] This creates important legal limitations to crowdfunding initiatives, given that the input of the crowd is capital and not an idea or time. Therefore, most initiatives do not offer shares but provide other types of rewards such as a product or membership.

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[5]Refer to O'Reilly (2007) for an in-depth understanding of Web 2.0.

[6]Some institutions such as the Red Cross and NGOs also rely on the crowd to secure funding, without making direct use of the Internet. This is however impossible for entrepreneurs or artists.

[7]For instance, *MediaNoMad* could not have more than 100 shareholders, as imposed by French law (Larralde and Schwienbacher, 2010). While the crowdfunding process of this company was made in the public domain, shareholder contracts for the purchase of shares were however only signed with 100 individuals, as a way to overcome these legal problems. In the case of *Trampoline Systems*, the company was required to prepare a detailed mechanism in order to avoid any problems with the UK financial markets regulator. More recently (unrelated however to crowdfunding concerns), Facebook faced scrutiny from the US securities regulator because their recent attempt to issue new equity could lead the firm to have more than 500 shareholders, the legal limit in the US for private firms.

Crowdfunders make voluntary financial contributions with or without the expectation of receiving compensation. This can take various forms, including cash, bonds, stocks, profit sharing and pre-ordering of products. At times, this can be accompanied by voting rights or other active involvement in the crowdfunding initiative. Our empirical study will provide evidence on different types of rewards and rights, as well as the magnitude of the financial contributions generated through crowdfunding. In practice, entrepreneurs relying on crowdfunding may combine it with other forms of crowdsourcing.

Crowdsourcing differs in many ways from open-source practices (Brabham, 2008); some of these differences can be transposed to crowdfunding. An important distinction is that in the case of open-source, the idea belongs to the community who can then exploit it on an individual basis (there is no restriction on who can use it); in the case of crowdsourcing, the generated idea ultimately belongs to the company who will be the only one to exploit it. This distinction with open-source practices becomes even more obvious when related to crowdfunding, since capital cannot be shared. Unlike an idea or a software code, capital is not a public good in the economic sense that assumes non-rivalness and non-excludability. Under these conditions, a public good is a good that can be used by many consumers at the same time, without duplicating costs.

Based on this discussion and in the spirit of Kleemann et al. (2008), we offer the following, refined definition:

Definition 1 *Crowdfunding involves an open call, mostly through the Internet, for the provision of financial resources either in form of donation or in exchange for some form of reward and/or voting rights.*

2.2 A survey analysis of crowdfunding

To obtain a better understanding of how crowdfunding initiatives are structured, we collected survey data on a "larger" sample of initiatives. In this section, we first describe the data collection process and discuss our empirical findings. In particular, we derive implications from the industrial organization point of view. These will lead to building blocks for our theoretical framework in the next section.

Data collection. To shed light on the structure of crowdfunded investments, we hand-collected data from various sources on all possible crowd-

funding initiatives that we could identify on the Internet. Data collected provide useful information on the funding outcome, on the type of investment, on the compensations for crowdfunders, on the type of organizational forms used, on communication methods used, on the location of crowdfunded ventures, and on the type of industries.

Data collection took place end of 2009 and early 2010. Since there is no database available or even listing, we relied on the Internet to construct our sample. Our focus was on crowdfunded ventures and projects, and not platforms that act as intermediary. In total, we identified 88 cases and we were able to collect sufficient (but still partially incomplete) information on 51 of them. We further sent a questionnaire to all the crowdfunded initiatives that we included in our sample in order to obtain additional and missing information. In total, 69 entrepreneurs have been contacted[8] and 21 completed questionnaires have been received (some only partially). The response rate in this survey is therefore around 30%.[9]

Findings. Table 1 in the data appendix provides summary statistics of the full sample and results of the survey. The data confirm that crowdfunding is a recent phenomenon for entrepreneurial initiatives. Indeed, over 80% of the respondents have used crowdfunding for projects or their own company most recently only (i.e., starting in 2007). 35.3% are from the United States and 49% from Europe. 63.2% are managed by a single founder, 15.8% by two founders and 21.1% by three founders (the highest number of founders observed in our sample). 70% of these founders hold a university degree, 10% are still attending the university.

Raising money was a strong motivation for all respondents, getting public attention was relevant (or highly relevant) for over 85%, and obtaining feedback for the product/service offered was still relevant (or highly relevant) for about 60% of the respondents. Many of them combine crowdfunding with other sources of finance, notably with own money, friends & family money, business angels and government subsidy. 76.5% offer to their crowdfunders

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[8]For some ventures, we could not identify a clear email address to contact them.

[9]Despite the high response rate, the total sample remains relatively small; this in turn could inevitably raise potential statistical concerns. Indeed, this may induce some small-sample bias for which it is difficult to control; on the other hand, crowdfunding is a nascent phenomenon so that our initial sample of 88 initiatives converges toward the entire population.

a reward, mostly in the form of a right to receive the product (for two thirds of the cases) or of shares that may yield dividends in the future. Direct cash payment is expected in 22.2% of the cases where a reward/return is promised. We also note that, in two thirds of the cases, other forms of reward are afforded (e.g., credit given on an album or a film, money transferred to a charity of the person's choice, etc).

Our study distinguishes different forms of investment: donation, active investment, and passive investment. As pointed before, pure donation constitutes 22% of crowdfunding. The rest represents investments (i.e., the crowdfunder expects to receive a return or reward), ventilated between active investment and passive investment, which count respectively for 32% and 60%.

In terms of means of communication, it is worthwhile to note that virtually all initiatives used very extensively the Internet as a mode of communication with the "crowd", evidencing the reliance on Web 2.0 for modern crowdfunding. Internet enables broad access to a community that may share similar goals and views. The most widely used methods of Internet is the firm's website, community blogs, Facebook and Twitter. Other methods are used by less than 50% of the respondents. However, only 20% of them (according to our survey) used a crowdfunding platform such as *Couch Tycoon.*

Besides, most entrepreneurs have recourse to crowdfunding in connection with a specific project only (in 46% of the cases). This means of funding is used by non-profit associations in 16% of the cases, whereas over 35% of our sample represents profit-oriented firms.

2.3 Key features from an industrial organization perspective

From the reading of the previous survey analysis, we propose here a number of issues that seem interesting to study from an industrial organization (IO) perspective.

Crowdfunding is not just about funding; it is also about information. Although raising money is reported to be a strong motivation for organizations to use crowdfunding, it is also observed that crowdfunding is rarely used as the only source of funds. Moreover, other motivations for resorting to crowdfunding are seen as equally important; in particular, getting public attention and obtaining feedback on the product/service offered. Crowdfunding seems thus to have implications that go beyond the financial sphere of an organi-

zation: it also affects the flow of information between the organization and its customers. Crowdfunding can be used as a promotion device, as a means to support mass customization or user-based innovation, or as a way for the producer to gain a better knowledge of the preferences of its consumer. All these topics have already been studied in IO but never (to the best of our knowledge) in combination with the funding issue.

Crowdfunding is a peculiar form of funding, with customers often acting as investors. The data reveal that a large share of crowdfunding initiatives are based on passive investments, i.e., investments with a promise of compensation but no direct involvement in the decision-making process, or provision of time or expertise for the initiative. Moreover, in most of the cases, the compensation is to receive a product or service from the financed activity. Hence, crowdfunding blurs the usual divide between the roles of investors and of customers: some investors are customers and some customers are investors. To account for this possible double role, traditional models of IO should be extended in two directions: first, by enlarging the set of actions for consumers (who can decide to become investors of the firm); second, by redefining the objective function of the firm as some investors, namely these customers/investors, may have different motivations than profit-maximization.

Non-profit organizations tend to be more successful in using crowdfunding. This finding suggests that the choice of a funding method (crowdfunding vs. other sources of funding) has to be considered in combination with the choice of an organizational form (for-profit vs. non-profit). The latter choice is not commonly studied in IO where profit-maximization is most often implicitly assumed to be the objective of an organization. One may argue that non-profit organizations stand outside the scope of IO, and are more relevant to public economics. This may be true for charities, but it is not with charities that we are dealing here: all crowdfunding initiatives in the sample are commercial ventures; it is also observed that only a limited fraction of initiatives is based on donations.

In Section 3, we present a model that addresses the key features presented here, in particular the fact that crowdfunding mixes funding and information motivations. Also, we incorporate the fact that the investing "crowd" may also be consumers and therefore has an interest in having the project realized not just for purely financial reasons. In this model, the firm

uses crowdfunding to induce consumers to reveal their private information, i.e., their willingness to pay for the product. When the investing crowd is also acting as consumer, their pre-ordering enables price discrimination. The drawback is that the extent to which the price-setting for both groups is optimal depends on the financing needs for setting up production. If the amount is very large, the entrepreneur needs to induce more consumers to pre-order through the crowdfunding initiative; this in turn constraints the entrepreneur in his/her ability to set different prices for the two types of consumers (those who contributed and those who did not). Then, the price discrimination scheme becomes less efficient and the entrepreneur will find it more profitable to opt for traditional finance. Our results from this tradeoff show the importance of identifying the right community, as crowdfunding in our framework is only superior to traditional financing if the investing crowd enjoys additional private benefit from participating in the crowdfunding process. If this is not the case, crowdfunding is always suboptimal.

Before developing these models, we close this section by describing the literature that could be used to study the above set of issues.

2.4   Related literature

As crowdfunding is a relatively new phenomenon, it is no surprise that the literature specifically devoted to crowdfunding is only nascent. Kappel (2009) distinguishes *ex post facto* crowdfunding (when, e.g., a product is offered after financing is provided) from *ex ante* crowdfunding (when in addition to patronage perks, crowdfunders have the opportunity to earn a monetary return on their contribution based on future sales). He notes that the latter form of crowdfunding is increasingly used in the recording industry and explores the legal impediments that have thus far prevented this kind of models in the United States. Wojciechowski (2009) discusses donations in connection with projects funded through crowdfunding. He argues that social networks can become a worthwhile model of money collection for many charity organizations and NGOs.

Though instructive, the latter two papers lie outside the realm of industrial organization. Closer to our analysis are two recent papers. Agrawal, Catalini and Goldfarb (2010) examine the geographic origin of consumers who invest on the *SellaBand* platform. They observe that "the average distance between artist-entrepreneurs and investors is about 3,000 miles, sug-

gesting a reduced role for spatial proximity." However, they establish that distance still plays a role insofar as "local investors are more likely than distant ones to invest in the very early stages of a single round of financing and appear less responsive to decisions by other investors."

The idea that investors may be responsive to other investors' decisions is also present in Ward and Ramachandran (2010). The goal of this paper is to estimate the extent to which demand for crowdfunding projects is driven by peer effects. Like in our model, it is assumed that consumption cannot happen until projects successfully complete their funding. What differs is the link that the authors make between crowdfunding and information. While we assume that crowdfunding allows the firm to gain information about its consumers, they posit that crowdfunding allows consumers to refine their information about the quality of an experience good. In their model, crowdfunders may update based on information from their investor social network. Adapting the peer-effect model of Oestreicher-Singer and Sundararajan (2010) and using also data from *Sellaband*, they find that crowdfunders are influenced by the success or failure of related projects and use the actions of other crowdfunders as a source of information in their funding decisions.

More broadly, our analysis of crowdfunding can be related to other strands of the literature. First, looking at crowdfunding from a pure financial perspective, connections can be made with the branch of research that deals with bootstrap finance. Bootstrap finance consists of using alternative financing ways than the traditional sources of external finance (e.g., bank loan, angel capital and venture capital). Several studies provide evidence of the different forms of alternatives used by bootstrapping entrepreneurs (see Bhidé (1992), Winborg and Landstrom (2001) and Ebben and Johnson (2006), just to cite a few). Bhidé (1992) shows that even among the Inc. 500 companies in the US, most of them started by bootstrapping the company. Further financing methods for startups companies are analyzed, for instance, by Cosh et al. (2005), who examine a broader range of financing alternatives. None of these studies however consider crowdfunding as possible alternative.

Finally, when crowdfunding follows a threshold pledge approach (whereby all pledges are voided unless a minimal amount is reached before some deadline), we can see initial investors as privately contributing to a public good;

through their contribution, they indeed increase the probability that the good or service will be put on the market. Our analysis can then be related to the extensive literature in microeconomics that studies the private provision of public goods (starting with Samuelson, 1954). However, in contrast with what is usually assumed in this literature, the good that is produced once the threshold is reached is private in nature (there is no collective consumption).

3 Crowdfunding, pre-ordering and menu pricing

In this section, we focus on crowdfunding experiences where consumers are invited to pre-order the product. This type of crowdfunding constitutes a large fraction of the sample presented in Section 2.

For the firm to be able to launch production, the amount collected through pre-ordering must cover the fixed cost of production. Since the remaining consumers will pay a different price, crowdfunding that takes the form of pre-ordering gives the opportunity to price discriminate between the first group (those who pre-order and thus constitute the investing "crowd") and the second group (the other consumers who wait that production takes place before purchasing directly).

Since the consumers who pre-order are those with a high willingness to pay for the product, these will generally constitute the bulk of the "crowd". However, a firm is generally unable to identify these consumers. The firm must then use some self-selecting device so as to induce high-paying consumers to reveal themselves. The sort of 'community experience' that web-based crowdfunding offers may be a means by which the firm enhances the perceived quality of the product for the consumers who agree to pre-order it. In this sense, crowdfunding appears as a form of menu pricing (i.e., of second-degree price discrimination).

The trade-off we explore in this section is thus the following: compared to external funding, crowdfunding has the advantage of offering an enhanced experience to some consumers and, thereby, of allowing the firm to practice second-degree price discrimination and extract a larger share of the consumer surplus; the disadvantage is that the firm is constrained in the first period by the amount of capital that it needs to raise. The larger this amount, the more consumers have to be attracted to cover it, which even-

tually reduces the profitability of the menu pricing scheme.

In what follows, we first present the model to be analyzed; we then derive, in turn, the outcome under traditional sources of financing (such as debt) and under crowdfunding; finally, we derive the optimal funding choice and we discuss the relevance of our result with respect to our empirical observations. We examine three extensions of the model in the next section.

3.1 Model

Suppose a unit mass of consumers identified by θ, with θ uniformly distributed on $[0, 1]$. The parameter θ denotes a consumer's taste for an increase in product's quality. Consumers have unit demand (they buy one or zero unit of the product). All consumers have a reservation utility $r > 0$ for the product; any increase from the basic quality is valued in proportion to the taste parameter θ. Normalizing basic quality to zero, we have that if consumer θ buys one unit of product of increased quality s sold at price p, her net utility is $r + \theta s - p$.[10] To ensure interior solutions at the pricing stage, we assume:

Assumption 1. $r < s < 2r$.

The product is marketed by a monopolist. In this simple version of the model, we consider the quality of the product, s, as exogenous.[11] For simplicity, we set to zero the marginal cost of production. There is, however, a fixed cost of production $K > 0$. The timing of the game is as follows. In period zero, the firm chooses its funding mechanism—traditional funding or crowdfunding—with the following implications. If the firm chooses traditional funding, then, in period 1, it incurs the fixed cost K, which is financed through, e.g., a bank loan; in period 2, the firm sets a price p for its product, and consumers decide to buy or not.

On the other hand, if the firm chooses crowdfunding, then it is able to set a menu pricing scheme. In period 1, the firm sets p_1, the price for consumers who pre-order the product; the total revenue collected through pre-orders is meant to cover the fixed cost of production. In period 2, the firm sets two prices: p_c, the price to be paid by those consumers who have

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[10]This problem was initially examined by Mussa and Rosen (1978). We use here the results of the extended analysis of Bhargava and Choudary (2001).

[11]In Section 4, we briefly discuss how the choice of quality could be affected by the for-profit or non-profit status of the firm.

contributed to the financing of the firm (the so-called "crowdfunders"), and p_r, the price to be paid by those consumers who have not (the so-called "regular consumers").[12] As for consumers, they choose in period 1 whether to pre-order or not; in period 2, they decide whether to purchase the product or not (as long as the product has been put on the market, i.e., if total contributions in period 1 are at least as large as K). It is assumed that contributors enjoy an increase in the product quality equal to $\sigma > 0$; that is, a consumer who pre-order the product perceives the quality of the product to be equal to $s + \sigma$. We make the following two assumptions regarding the value of σ:

Assumption 2. $\sigma < s$.

Assumption 3. $\sigma = 0$ *if no regular consumer buys the product in period 2.*

Assumption 2 simply states that all consumers value more the original quality of the product (s) than the increase in perceived quality (σ). Assumption 3 stems from a particular interpretation of σ. We have observed above that the enhanced quality may come from different experiences resulting from crowdfunding: early acquaintance with the product, customization of the product, sense of belonging to a group of 'special consumers'. It is the latter interpretation of so-called 'community benefits' that Assumption 3 aims to translate. As we focus on the price discrimination aspect of crowdfunding, we suppose that the value of the enhanced quality σ can only accrue if the market is actually segmented between crowdfunders and regular consumers; indeed, crowdfunders cannot derive any utility from being treated differently if there exist no regular consumer that they can compare to.[13]

The monopolist maximizes the present discounted value of its profits over the two periods. Consumers maximize the present discounted value of their net utility over the two periods. We assume that the firm and the consumers have the same discount factor and we let $0 < \delta \leq 1$ denote it.

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[12]The firm is able to recognize consumers who pre-ordered in period 1 and therefore to distinguish them from regular consumers; no personal arbitrage is thus possible in period 2.

[13]This assumption is line with our empirical observations: while some crowdfunding initiatives offer monetary rewards, an important other form of reward is recognition or credits offered to the "crowd". Anyway, we show in Section 4 that the qualitative nature of our results is preserved when we consider other interpretations of σ that do not require an actual segmentation of the market.

Two comments are warranted on the pricing schedule, which is meant to be very general. First, contributors pay $p_1 + \delta p_c$ in total, other consumers δp_r. This framework encompasses several, more restrictive schemes, including full pre-payments (where contributors pay one single amount upfront, equal to $p_1 + \delta p_c$) as well as ex post price discrimination (where each type pays a different price). This means that we do not exogenously impose p_c and p_r to be identical, although the framework here allows for this. Second, by enabling the participating crowd to pay upfront only part of their contribution, we avoid any price setting in which the entrepreneur would raise funds well beyond what he really needs, namely K. Here, contributors provide in period 1 merely what is needed for starting production, the rest being paid in period 2.

We now consider the choice of prices under the two funding mechanisms. We then compare optimal profits in the two cases and address the choice of funding mechanism.

3.2 Traditional funding

The case of traditional funding is straightforward. In period 1, the firm gathers funds and in period 2, it sets a uniform price p. All consumers perceive that the product has quality s. Hence, the indifferent consumer is such that $r + \theta s - p \geq 0$, or $\theta \geq (p - r)/s \equiv \hat{\theta}$. As we assume a unit mass of consumers uniformly distributed on the unit interval, we have that the quantity demanded is equal to $q(p) = 1 - \hat{\theta} = 1 - (p - r)/s$. From the first-order condition for profit-maximization, we easily find that the optimal price is $p^* = (r + s)/2$. It follows that $\hat{\theta}^* = (s - r)/2s$, which is positive according to Assumption 1. We can then compute the optimal gross profit as $p^* \left(1 - \hat{\theta}^*\right) = (r + s)^2/(4s)$. The net profit under traditional funding is thus equal to

$$\pi_{\text{trad}} = \begin{cases} \delta \frac{(r+s)^2}{4s} - K & \text{for } K < \delta \frac{(r+s)^2}{4s}, \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

3.3 Crowdfunding

The crowdfunding case is more complicated to analyze for two reasons. First, the firm tries to achieve a form of second-degree price discrimination; profit is thus maximized under a set of incentive compatibility and participation

constraints. Second, in period 1 consumers who contemplate pre-ordering the product must form expectations regarding the number of consumers who will do likewise: the larger this number, the lower the pre-ordering price as the fixed cost will be spread over more consumers, which generates a form of network effects.

3.3.1 Consumer choices

Suppose that each consumer expects that a mass n^e of consumers will choose to pre-order and pay the price p_1 set by the firm in period 1.[14] We adopt the fulfilled-expectations approach: consumers base their decision on their expectation on the mass of contributors, and attention is restricted on equilibria in which these expectations turn out to be correct (i.e., are rational; see Katz and Shapiro, 1985). Two cases have to be distinguished. First, if $n^e = 0$, then it is optimal for each consumer not to contribute.[15] As the initial expectation is realized, we have a fulfilled expectations equilibrium. Naturally, crowdfunding is doomed to failure under such equilibrium. As some successful crowdfunding experiences exist in reality, it seems natural to assume that firms can find some ways to coordinate consumers so that this 'bad' equilibrium is not selected.

The second case is the case of interest. For any $n^e > 0$, the firm can set p_1 such as $p_1 n^e \geq K$. As there is no need to gather more capital than needed, we have $p_1 = K/n^e$. So, if consumers expect a positive mass of contributors, they can be sure that the good will be produced.[16] They also realize that the lower their expectation, the larger the value of p_1, i.e., the contribution that will be asked by the firm.

To decide whether to pre-order or not, consumer θ compares her expected utility in the two options. If she contributes, she pays p_1 today and gets tomorrow a product of enhanced quality $(s + \sigma)$ that she will pay at price

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[14]This setting is clearly a simplification. In many crowdfunding experiences, consumers (or more generally, donors) are invited to choose how much they want to contribute. We ambition to relax this simplifying assumption in future work.

[15]This is so because each consumer is infinitesimal and thus cannot on her own make sure that the product will be put on the market; on the other hand, even if the early contribution will be reimbursed, this will take some time and there will thus be some loss for the consumer.

[16]Provided that the monopolist does not find it profitable to run away with the contributions at the start of period 2. We will consider to this issue in Section 4.

p_c. We can thus express the expected utility of a crowdfunder as

$$U_c^e = -p_1 + \delta \left(r + \theta \left(s + \sigma \right) - p_c \right) = -\frac{K}{n^e} + \delta \left(r + \theta \left(s + \sigma \right) - p_c \right).$$

If the consumer decides not to pre-order, she does not pay anything today and she gets tomorrow a product of quality s at price p_r. Hence, her expected utility as regular consumer is

$$U_r^e = \delta \left(r + \theta s - p_r \right).$$

So, for a consumer to contribute, we must have

$$\begin{aligned} U_c^e & \geq U_r^e \Leftrightarrow \delta \left(\theta \sigma + p_r - p_c \right) \geq \frac{K}{n^e} \\ & \Leftrightarrow \theta \geq \frac{K}{\delta \sigma n^e} - \frac{p_r - p_c}{\sigma} \equiv \bar{\theta} \left(n^e \right). \end{aligned}$$

All consumers with a value of θ larger than $\bar{\theta} \left(n^e \right)$ prefer to pre-order. We observe logically that the mass of crowdfunders increases as (i) the expected number of contributors (n^e) increases, (ii) the capital requirement (K) decreases, (iii) the enhancement in quality (σ) resulting from pre-ordering increases, (iv) the difference between the price for regular consumers and for crowdfunders $(p_r - p_c)$ increases.

To ease the exposition, we introduce two pieces of notation: we define $\Delta \equiv p_r - p_c$ and $k \equiv K/ \left(\delta \sigma \right)$; that is, Δ is the difference between the second period prices for regular consumers and crowdfunders, while k is the ratio between the capital requirement and the discounted value of the extra quality provided by the community experience.

For a given expected mass of crowdfunders n^e, the actual mass of crowdfunders is equal to $n = 1 - \bar{\theta} \left(n^e \right)$. We require fulfilled expectations at equilibrium: $n = n^e$. We must thus solve

$$n = 1 + \frac{\Delta}{\sigma} - \frac{k}{n}.$$

This equation is represented in Figure 1: solutions are the intersection between the 45° line (n) and the function $1 + \frac{\Delta}{\sigma} - \frac{k}{n}$, which is increasing and concave in n. Figure 1 depicts the latter function for different values of Δ. We observe that an intersection exists as long as

$$\Delta \geq \sigma \left(2\sqrt{k} - 1 \right) \equiv \underline{\Delta}. \tag{2}$$

To understand the meaning of this condition, let us describe what happens when it is violated. For $\Delta < \underline{\Delta}$, the price charged to crowdfunders is not sufficiently smaller than the price charged to other consumers, so that a large value of n^e is needed to convince consumers to pre-order the product; indeed, the larger the expected number of crowdfunders, the lower the price p_1 each crowdfunder has to pay in period 1, which increases the attractiveness of pre-ordering, other things being equal. Yet, the number of consumers who actually decide to pre-order always remains smaller than the expected number, meaning that expectations cannot be fulfilled (i.e., there is no solution to the above equation). Note that the threshold $\underline{\Delta}$ logically increases with K: the higher the capital requirement, the more difficult it becomes for expectations to be fulfilled. Note also that at $\Delta = \underline{\Delta}$, there is a unique solution, which is easily computed as $n = \sqrt{k}$. Keeping in mind that $n \leq 1$, we make the following assumption:

Assumption 4. $K < \delta\sigma$ (or equivalently $k < 1$).

For $\Delta > \underline{\Delta}$, there are two intersections. As we expect the mass of crowdfunders to increase with Δ, we select the largest value of n, which is computed as

$$n = \frac{1}{2\sigma}\left(\sigma + \Delta + \sqrt{(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2}\right). \tag{3}$$

As shown in Figure 1, this value is strictly smaller than unity for $\Delta < \sigma k$.[17]

(INSERT FIGURE 1 ABOUT HERE)

3.3.2 Optimal prices

Suppose for now that $n < 1$. We have then that n consumers pre-order the product at price p_1 and buy it in period 2 at price p_c. As for the other consumers, they buy the product as long as $r + \theta s - p_r \geq 0$, or $\theta \geq (p_r - r)/s \equiv \hat{\theta}$. As long as $0 < (p_r - r)/s < 1 - n$, the firm's profit can be written as

$$
\begin{aligned}
\pi &= \underbrace{p_1 n - K}_{=0} + \delta p_c n + \delta p_r\left(1 - n - \frac{p_r - r}{s}\right) \\
&= \delta p_r\left(1 - \frac{p_r - r}{s}\right) - \delta\Delta\frac{1}{2\sigma}\left(\sigma + \Delta + \sqrt{(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2}\right),
\end{aligned}
$$

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[17]It can easily be checked that σk is larger than $\underline{\Delta}$. For $\Delta \geq \sigma k$, we have that $n = 1$ (the fulfilled-expectations equilibrium is such that all consumers become crowdfunders).

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where the second line is obtained by substituting expression (3) for n, and Δ for $p_r - p_c$.

It is easily found that the first-order condition with respect to p_r yields the optimal value $p_r^* = (r + s)/2$, which implies that $\hat{\theta} = (p_r^* - r)/s = (s - r)/2s$.

The derivative of profit with respect to Δ is

$$\frac{d\pi}{d\Delta} = -\frac{\delta}{2\sigma} \left[\sigma + 2\Delta + \sqrt{(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2} + \frac{\Delta(\sigma + \Delta)}{\sqrt{(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2}} \right]. \quad (4)$$

It is clear that the bracketed term is strictly positive for positive values of Δ. Hence, any interior solution must be such that $\Delta < 0$ (i.e., that $p_r < p_c$, meaning that crowdfunders pay more than other consumers in period 2). Because of the constraint imposed by (2), this is only possible if $\underline{\Delta}$ is negative, which is equivalent to $k < 1/4$. We therefore have to distinguish between two cases (we sketch the results here and refer the reader to the mathematical appendix for the detailed computations).

Case 1. $k < 1/4$. In this case, we solve $d\pi/d\Delta = 0$ for Δ and find :

$$\Delta^* = \frac{\sigma(4k - 1)}{2}. \quad (5)$$

We verify that $k < 1/4$ implies that $\Delta^* < 0$, i.e. that $p_c^* > p_r^*$: crowdfunders pay more than other consumers in period 2 (we will return to this below). We also compute that the number of crowdfunders is given by $n^* = 1/2$. Hence, at (p_r^*, Δ^*), consumers split into three groups: those with $\theta \in [0, (s - r)/2s]$ do not consume, those with $\theta \in [(s - r)/2s, 1/2]$ buy in period 2, and those with $\theta \in [1/2, 1]$ pre-order in period 1. We then compute the optimal profit as

$$\pi = \delta\frac{(r + s)^2}{4s} + \frac{\delta\sigma}{4} - \delta\sigma k. \quad (6)$$

Case 2. $k \geq 1/4$. Here, $\Delta \geq 0$ under condition (2). Then, expression (4) is clearly negative, meaning that the optimal choice is the lowest admissible value of Δ, i.e., $\Delta = \underline{\Delta} > 0$. The intuition goes as follows: the higher capital requirement, combined to the fulfilled expectations requirement, forces the firm to give a discount to crowdfunders ($p_c < p_r$) but the firm prefers to keep this discount as small as possible. The number of crowdfunders is then given by

$$\underline{n} = \frac{1}{2\sigma}(\sigma + \underline{\Delta}) = \sqrt{k} \geq \frac{1}{2}.$$

We see thus that the monopolist has to attract a larger number of crowd-funders than in the previous, unconstrained, case; this number grows with K (and remains smaller than unity according to Assumption 4).

As the number of crowdfunders grows, it is not clear whether the firm still finds it optimal to attract non-contributors in period 2. It does so as long as $(p_r^* - r)/s < 1 - \underline{n}$, where $p_r^* = (r + s)/2$; the latter condition is equivalent to

$$k < \frac{(r + s)^2}{4s^2} \equiv k_1.$$

It can be checked that the threshold k_1 is comprised between $1/4$ and 1. We have then $p_c^* = (r + s)/2 - 2\sigma\sqrt{k} + \sigma$ and

$$\pi = \delta\frac{(r + s)^2}{4s} - 2\delta\sigma k + \delta\sigma\sqrt{k}. \tag{7}$$

Otherwise, we have a corner solution such that the monopolist does not attract any new consumer in period 2. Under Assumption 3, the absence of regular consumers in period 2 implies that σ falls to zero, which makes crowdfunding impracticable.

Collecting our results, we can express profits in the crowdfunding case as

$$\pi_{\text{crowd}} = \begin{cases} \delta\frac{(r+s)^2}{4s} + \frac{\delta\sigma}{4} - \delta\sigma k & \text{for } k < \frac{1}{4}, \\ \delta\frac{(r+s)^2}{4s} - 2\delta\sigma k + \delta\sigma\sqrt{k} & \text{for } \frac{1}{4} \leq k < k_1, \\ 0 & \text{for } k \geq k_1. \end{cases} \tag{8}$$

3.4 Choice of funding method

To ease the comparison between the profit levels under the two funding methods, we express the profits under traditional funding by using the notation $k = K/(\delta\sigma)$:

$$\pi_{\text{trad}} = \begin{cases} \delta\frac{(r+s)^2}{4s} - \delta\sigma k & \text{for } k < \frac{(r+s)^2}{4\sigma s} \equiv k_2, \\ 0 & \text{otherwise.} \end{cases} \tag{9}$$

Note that Assumption 2 (i.e., $\sigma < s$) implies that $k_2 > k_1$, meaning that traditional funding makes production profitable for a larger range of values of the fixed cost K than crowdfunding. Now, comparing expressions (8) and (9), we observe first that for small values of k ($k \leq 1/4$), crowdfunding clearly yields larger profits than traditional funding. The intuition is obvious: in this region of parameter, crowdfunding allows the firm to optimally price

discriminate between the high-valuation crowdfunders and the remaining consumers. As the 'enhanced quality' σ comes at no cost for the firm, menu pricing performs better than the uniform pricing that prevails under traditional funding.

For larger values of k, however, the firm is constrained to implement corner solutions under crowdfunding. Here, σ is no longer a sort of 'manna from heaven' for the firm: the network effects among crowdfunders and the requirement of fulfilled expectations constrain the prices that the firm can choose, which inevitably reduces its profits. Nevertheless, we find that profits are still larger under crowdfunding than under traditional funding. Indeed, we compute $\pi_{\text{crowd}} - \pi_{\text{trad}} = \delta\sigma\sqrt{k} - \delta\sigma k$, which is positive as $k < k_1 < 1$.

Finally, for still larger values of k, only traditional funding allows the firm to make a profit. We collect our results in the following proposition and we depict them in Figure 2.

Proposition 1 *In situations where a firm can use crowdfunding and pre-sales to induce self-selection of high paying consumers, crowdfunding is preferred over traditional funding if $K < \delta\sigma\left(r + s\right)^2 / \left(4s^2\right)$.*

(INSERT FIGURE 2 ABOUT HERE)

One important implication of Proposition 1 is that the level of additional benefits accruing to the pre-ordering crowd (i.e., σ) must be sufficiently large. If the crowd does not enjoy any of such benefits or utility, crowdfunding does not yield any benefits over traditional funding for the firm. The parameter σ can be seen as additional utility or benefits from a community-based experience. Then, the lack of a community would result in a value of σ equal to zero. An important implication is the need for the firm to identify and target this community. While consumers with a high willingness to pay for the product may self-select themselves into the community, the firm still needs to ensure that the "crowd" can generate these additional benefits. The following managerial lesson can thus be drawn from our analysis: *entrepreneurs who cannot identify or create a community around their products so that this community enjoys additional benefits, will hardly ever opt for crowdfunding.* Indeed, we observe on Figure 2 that as σ decreases, the range of values of K for which crowdfunding is preferred narrows down.

The previous finding is consistent with many experiences made in crowd-funding initiatives included in the sample of the survey analysis. Indeed, while some offer monetary rewards, an important other form of reward is recognition or credits offered to the "crowd". The importance of non-monetary benefits for crowdfunders is further stressed by the observation that *at equilibrium, crowdfunders always end up paying a larger total price than other consumers*. To see this, let us compare equilibrium prices for the two categories of consumers. The (discounted) price for regular consumers is always equal to $\delta p_r^* = \delta (r + s) / 2$. The price for crowdfunders is the following non-increasing function of the capital requirement K:

$$p_1^* + \delta p_c^* = \begin{cases} \frac{1}{2}\delta (r + s + \sigma) & \text{for } k < 1/4 \\ \frac{1}{2}\delta (r + s + \sigma) - \delta\sigma \left(\sqrt{k} - \frac{1}{2}\right) & \text{for } 1/4 \leq k < k_1 \end{cases}$$

It can be checked that for $k < k_1$, $p_1^* + \delta p_c^* > \delta p_r^*$.

Note that to keep our model tractable, we made a couple of simplifying assumptions regarding the community benefits. First, we assumed that consumers value s and σ in the same way; that is, the consumers who are willing to pay more for the intrinsic quality of the product are also those who are willing to pay more for the community benefits. Alternatively we could assume that consumers have uncorrelated preferences over these two dimensions. Second, we assumed a constant value σ; this implies in particular that the community benefits do not depend on the size of the community. However, some crowdfunding initiatives in our survey suggest otherwise: community benefits may increase or decrease with the size of the community.[18] We plan to examine these alternative assumptions in future work.

4   Extensions

In this section, we extend our analysis in three directions. First, we discuss the credibility issue that arises when the monopolist cannot commit to the production of the good in the second period. Second, we examine the case where the extra benefit σ also accrues when only crowdfunders stay on the

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[18]They may increase if the fit between the product offered and the consumers' tastes improves when the community grows larger; they may decrease when crowdfunders are rewarded by being credited on an album (as any particular name becomes less visible when the number of names on the album increases).

market. Finally, we try to relate our model to our empirical finding that non-profit organizations tend to be more successful in using crowdfunding.

4.1   Take the money and run

In the previous analysis, we have abstracted away the possibility that the monopolist could "take the money and run" at the start of period 2, i.e., to collect p_1 from the crowdfunders without incurring the fixed cost and thus, without producing the product. That is, we implicitly assumed that the monopolist had some form of commitment at its disposal to guarantee its second-period activity. Absent such commitment device, consumers would only be convinced that production will take place if it is indeed in the monopolist's best interest; otherwise, no consumer would agree to pre-order the product and crowdfunding would fail. The monopolist's net profit when producing must then be larger than the total amount that is collected at the end of period 1, i.e., K. Using expression (8) and recalling that we defined $K = \delta\sigma k$, we can write the condition as

$$
\begin{cases}
\delta\frac{(r+s)^2}{4s} + \frac{\delta\sigma}{4} > 2\delta\sigma k & \text{for } k < \frac{1}{4}, \\
\delta\frac{(r+s)^2}{4s} + \delta\sigma\sqrt{k} > 3\delta\sigma k & \text{for } \frac{1}{4} \le k < k_1.
\end{cases}
$$

It is straightforward to show that Assumption 2 makes sure that the first line of the condition is satisfied; that is, when the optimal menu pricing scheme can be implemented, the monopolist has no incentive to take the money and run. As for the second line, it can be rewritten as

$$
-3k + \sqrt{k} + \frac{(r+s)^2}{4\sigma s} > 0 \Leftrightarrow k < \frac{1}{36}\left(1 + \sqrt{1 + 3\frac{(r+s)^2}{\sigma s}}\right)^2 \equiv k_3.
$$

A few lines of computations establish that $k_3 > \frac{1}{4}$ and $k_3 < k_1$ for $\sigma > \hat{\sigma} \equiv s\,(r+s)/(3r+s)$. This implies that when consumers may fear that the monopolist could take the money and run, crowdfunding becomes harder to implement: there exists indeed a region of parameters (characterized by high values of σ and K) where consumers will not agree to pre-order the product as they rightfully anticipate that the monopolist will not put the product on the market. For these parameters, traditional funding appears as the only option (assuming, of course, that banks are better equipped than crowdfunders to prevent the monopolist's default). Figure 3 illustrates this result.

<div align="center">(INSERT FIGURE 3 ABOUT HERE)</div>

4.2 Other interpretations of σ

In our previous analysis, we assumed that crowdfunding is not viable for values of the fixed cost such that $k > k_1$ because in that case, the monopolist cannot find prices such that regular consumers buy the product in period 2. This assumption was reasonable when σ was interpreted as a form of 'community benefits' that crowdfunders would enjoy when they feel that the monopolist grant them some 'privilege status' with respect to regular consumers. In contrast, other interpretations of σ (e.g., additional benefits stemming from an earlier acquaintance with the product) would not make crowdfunding depend so much on the presence of regular consumers.

We need then to examine the corner solution that obtains for $k > k_1$.[19] Here, the value of θ that makes a consumer indifferent between pre-ordering and buying in period 2 (i.e., $1 - \underline{n}$) would be smaller than the value of θ that makes a consumer indifferent between buying in period 2 and not consuming at all (i.e., $(p_r - r)/s$), which would violate one of the constraints of the maximization program. As the constraint becomes binding, we fix the price p_r such that $(p_r - r)/s = 1 - \underline{n}$ or $p_r = r + s(1 - \underline{n})$. It follows that $p_c^* = r + s + \sigma - (s + 2\sigma)\sqrt{k}$ and

$$\pi = \delta\left(r + s + \sigma - (s + 2\sigma)\sqrt{k}\right)\sqrt{k}.$$

Comparing the latter expression to the profit under traditional funding, we find that crowdfunding is preferred as long as $k \le k_4$, with

$$\sqrt{k_4} \equiv \frac{s(r + s + \sigma) + \sqrt{s\sigma(s\sigma + s^2 - r^2)}}{2s(s + \sigma)}, \text{ and } k_1 < k_4 < 1.$$

As depicted on Figure 4, we observe thus that the region of parameters where crowdfunding is preferred enlarges when we give a broader interpretation to the source of σ.

(INSERT FIGURE 4 ABOUT HERE)

It is important to stress that the gist of our general message remains unaltered in the two extensions that we have just considered. Figures 2 to 4 show indeed that *as the capital requirement increases, crowdfunding mechanisms that exploit menu pricing must provide larger additional benefits to crowdfunders if they want to prevail over traditional forms of funding.*

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[19]To be exhaustive, we should also examine the strategy that consists in proposing only pre-ordering and not allowing any purchase in period 2. As our focus is on menu pricing, we choose to ignore this strategy.

4.3 For-profit vs non-profit status

An implicit assumption of our model is that the entrepreneur is purely motivated by profits. As such, our analysis is thus silent about the third stylized fact that emerged from our empirical observations, namely that non-profit organizations tend to be more successful in using crowdfunding.

To analyze the choice of organizational form, we could use the insights from the so-called 'contract failure literature'. This literature is based on the view that limiting monetary incentives of owners attracts more easily donations, since it signals that the owners put a significant weight on the outcome and less on monetary gains. For instance, Glaeser and Shleifer (2001) propose a model where profit-driven organizations may be prone to focus too much on profits at the expense of other dimensions such as quality of the product or service provided. This in turn may not be desired from donors and other sources aimed at fostering specific initiatives. At the equilibrium of their model, non-profit entrepreneurs end up offering goods of higher quality than for-profit entrepreneurs.

How can we relate this result to the present analysis? In our model, the quality of the product is measured by the parameters s and σ: the former measures the intrinsic quality of the product and the latter, the extra quality provided by the community aspect of the crowdfunding experience. Suppose now that the game we analyzed was preceded by a quality choice stage à la Glaeser and Shleifer. Letting (s, σ) and (s_n, σ_n) denote, respectively, the choices of a for-profit and a non-profit entrepreneur, we would obtain

$$s_n = \alpha s, \sigma_n = \beta \sigma \text{ with } \alpha, \beta \geq 1.$$

To account for the fact that non-profit organizations tend to be more successful in using crowdfunding, we would need that the threshold value of K in Proposition 1 (under which crowdfunding is preferred) be larger for a non-profit than for a for-profit entrepreneur. This is so as long as

$$\frac{\delta \sigma_n (r+s)^2}{4 s_n^2} = \frac{\delta \beta \sigma (r+\alpha s)^2}{4 (\alpha s)^2} > \frac{\delta \sigma (r+s)^2}{4 s^2} \Leftrightarrow \beta > \left(\frac{\alpha r + \alpha s}{r + \alpha s} \right)^2.$$

It can be checked that $s > r$ (Assumption 1) implies that the latter equality is satisfied if $\beta = \alpha$, i.e., if a non-profit entrepreneur increases the two dimensions of quality in the same proportion compared to a for-profit entrepreneur. However, it is easily seen that the inequality is not satisfied for

$\beta = 1$ and $\alpha > 1$, i.e., if the increase in quality only concerns the intrinsic dimension. This suggests that *non-profit organizations may be more likely than for-profit organizations to use crowdfunding if (i) entrepreneurs deliver a higher quality when the firm is non-profit rather than for-profit ('contract failure' argument), and (ii) not only the intrinsic quality of the product is enhanced, but also the community-based experience enjoyed by crowdfunders.*

5   Concluding remarks

This paper sheds light onto crowdfunding practices to entrepreneurial activities. It further stresses the need for building a community to make crowdfunding a viable alternative to investor-based funding such as through banks, business angels or even venture capital. In setting up the initiative, the entrepreneur potentially faces the following tradeoff: crowdfunding allows for price discrimination if pre-ordering is used. The capacity to optimally implement price-discrimination between pre-ordering consumers (the "crowd") and other consumers may however be constrained by the amount of capital that the entrepreneur needs to raise to cover his/her upfront (fixed) costs. Whenever this amount exceeds some threshold, the distortion in the price-discrimination becomes excessive, in which case any crowdfunding initiative becomes inefficient and the entrepreneur is better off approaching a single, larger investor who can cover the full costs on its own. Importantly, the extent to which the entrepreneur is able to identify and build a community that ultimately enjoys additional private benefits from participating in the crowdfunding is particularly stressed in this paper.

Testable predictions, offered by our model, are consistent with observed data. Indeed, the growing success of a number of crowdfunding experiences confirm that the community (i.e, the critical mass of customers/investors) derives additional benefits. These experiences cater mainly to the entertainment industry (music, movies). However, many start-up ventures reproduce this new business model (e.g., in activities such as journalism) and their recent success reinforce our predictions.

To our knowledge, this is the very first study directly dealing with crowdfunding. Existing studies, while providing useful insights into the process, are limited to individual case studies or a single platform. While providing first-hand insights into the crowdfunding process, this study raises follow-

up questions that should be examined in future research. For instance, are these investments worthwhile for individuals? Compared to other means of financing, crowdfunding opportunities exhibit several important differences that are likely to affect risk-return profile of investors and motivations for providing money to crowdfunders.

Another avenue for future research is to incorporate the fact that the crowdfunders can at times also participate in strategic decisions or even have voting rights. In this case, control rights and voting power become an additional benefit for the participating crowd. Also, outcomes of votes can provide valuable insights into the optimal design of products if the voting community is representative for the overall population of end-consumers.

From a general perspective, crowdfunding practices raise questions with respect to corporate governance and investor protection issues if most individuals only invested tiny amounts. Crowdfunders are most likely offered very little investor protection. This may lead to corporate governance issues, which in turn may turn into reputation concerns if some cases of fraud or bad governance are uncovered. Crowdfunders have very little scope to intervene to protect their interests as stakeholders. Moreover, the fact that their investment is small is likely to create a lack of incentive to intervene. Therefore, trust-building is an essential ingredient for any successful crowdfunding initiative.

It is therefore not a surprise that many of the observed crowdfunded initiatives are either project-based or based on donations. In many cases, the financial return seems to be of secondary concern for those who provide funds. This suggests that crowdfunders care about social reputation and/or enjoy private benefits from participating in the success of the initiative (Glaeser and Shleifer, 2001; Ghatak and Mueller, 2009).

In any case, a strong advantage of this form of financing is the attention that the entrepreneur may attract on his/her project or company. This can become a vital asset for many of them, especially for artists or entrepreneurs in need to present their talent and product to the "crowd" (as potential customers). In other cases, it is a unique way to validate original ideas in front of a specifically targeted audience. This may in turn provide insights into market potential of the product or service offered. From this perspective, crowdfunding may be viewed as a broader concept than purely raising funds: it is a way to develop corporate activities through the process of fundraising.

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A Appendix

A.1 Mathematical appendix

Derivation of optimal prices in Case 1.

If $k < 1/4$, then there may exist a value of $\Delta \geq \underline{\Delta}$ that solves $d\pi/d\Delta = 0$, or

$$\sigma + 2\Delta + \sqrt{(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2} + \frac{\Delta(\sigma + \Delta)}{\sqrt{(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2}} = 0 \Leftrightarrow$$

$$\sqrt{(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2} = \frac{(\sigma + \underline{\Delta})^2}{\sigma + 2\Delta} - (\sigma + \Delta) \tag{10}$$

As long as the RHS is positive, we can take the square of the two sides of the equality:

$$(\sigma + \Delta)^2 - (\sigma + \underline{\Delta})^2 = \frac{(\sigma + \underline{\Delta})^4}{(\sigma + 2\Delta)^2} + (\sigma + \Delta)^2 - 2\frac{(\sigma + \Delta)(\sigma + \underline{\Delta})^2}{\sigma + 2\Delta},$$

which, after simplification, yields

$$\Delta^* = \frac{1}{2\sigma}\left[(\sigma + \underline{\Delta})^2 - \sigma^2\right] = \frac{1}{2\delta}\left(4K - \delta\sigma\right).$$

We still need to check whether condition (2) is satisfied:

$$\frac{1}{2\sigma}\left[(\sigma + \underline{\Delta})^2 - \sigma^2\right] > \underline{\Delta} \Leftrightarrow 2\sigma\underline{\Delta} + \underline{\Delta}^2 > 2\sigma\underline{\Delta},$$

which is true. We also need to check that the RHS of expression (10) is positive, as we assumed it. We compute

$$\frac{(\sigma + \underline{\Delta})^2}{\sigma + 2\Delta} > (\sigma + \Delta) \Leftrightarrow \frac{4\sigma K/\delta}{4K/\delta} > \frac{4K + \delta\sigma}{2\delta} \Leftrightarrow 2\delta\sigma > 4K + \delta\sigma \Leftrightarrow K < \delta\sigma/4$$

which is true.

To proceed, we compute

$$\sigma + \Delta^* = \frac{1}{2\sigma}\left[(\sigma + \underline{\Delta})^2 + \sigma^2\right]$$

$$\sqrt{(\sigma + \Delta^*)^2 - (\sigma + \underline{\Delta})^2} = \frac{1}{2\sigma}\left[\sigma^2 - (\sigma + \underline{\Delta})^2\right]$$

It follows that

$$n^* = \frac{1}{2\sigma}\left(\frac{1}{2\sigma}\left[(\sigma + \underline{\Delta})^2 + \sigma^2\right] + \frac{1}{2\sigma}\left[\sigma^2 - (\sigma + \underline{\Delta})^2\right]\right) = \frac{1}{2}.$$

Recall that we need

$$\frac{p_r - r}{s} < 1 - n \Leftrightarrow \frac{s - r}{s} < \frac{1}{2} \Leftrightarrow s < 2r,$$

which is guaranteed by Assumption 1.

We can now compute optimal profit:

$$
\begin{aligned}
\pi &= \delta\frac{(r+s)^2}{4s} - \delta\Delta^*\frac{1}{2\sigma\delta}\left(\delta\left(\sigma+\Delta^*\right) - \delta\Delta^*\right) \\
&= \delta\frac{(r+s)^2}{4s} + \frac{\delta\sigma}{4} - K.
\end{aligned}
$$

What do consumers pay in this case? It is easily checked that contributors pay $p_1 + \delta p_c = \frac{\delta}{2}\left(r+s+\sigma\right)$. Note that this is exactly the price that the firm would set if it was only selling in period 1 a product of quality $(s+\sigma)$ to be delivered in period 2. Indeed, the indifferent consumer would be identified by θ_0 such that $-p + \delta\left(r + \theta_0\left(s+\sigma\right)\right) = 0$, which is equivalent to $\theta_0 = \frac{1}{s+\sigma}\left(\frac{1}{\delta}p - r\right)$. The firm maximizes $\pi = \delta\left(p\left(1-\theta_0\right)\right)$. It is easy to check that the optimal price is $p = \frac{1}{2}\delta\left(r+s+\sigma\right)$. It can also be checked that the optimal profit is just equal to what the firm would achieve by setting p_1 for contributors in period 1 and a price p_2 for non-contributors in period 2 (contributors paying nothing in period 2).

Derivation of optimal prices in Case 2.

As explained in the text:

$$
\Delta^* = \underline{\Delta} = 2\sqrt{\frac{\sigma K}{\delta}} - \sigma,\, n^* = \sqrt{\frac{K}{\delta\sigma}},\, p_c^* = \frac{r+s}{2} - 2\sqrt{\frac{\sigma K}{\delta}} + \sigma.
$$

Assumption 4 guarantees that $n^* < 1$. We still need to check that $\left(p_r - r\right)/s < 1 - n^*$. This is so if

$$
\frac{s-r}{2s} < 1 - \sqrt{\frac{K}{\delta\sigma}} \Leftrightarrow \sqrt{\frac{K}{\delta\sigma}} < \frac{r+s}{2s} \Leftrightarrow K < \delta\sigma\left(\frac{r+s}{2s}\right)^2. \tag{11}
$$

As $r < s$ by Assumption 1, the latter condition is more stringent than Assumption 4 (i.e., $K < \delta\sigma$).

We then compute the optimal profit as

$$
\begin{aligned}
\pi &= \delta\frac{r+s}{2}\left(\frac{r+s}{2s}\right) - \delta\left(2\sqrt{\frac{\sigma K}{\delta}} - \sigma\right)\sqrt{\frac{K}{\delta\sigma}} \\
&= \delta\frac{(r+s)^2}{4s} + \sqrt{\delta\sigma K} - 2K.
\end{aligned}
$$

This profit is positive under the previous assumptions. We can indeed rewrite it as

$$
\pi = \left[\delta\frac{(r+s)^2}{4s} - K\right] + \left[\sqrt{\delta\sigma K} - K\right],
$$

where the first bracket is positive because of Assumption 2 (i.e., $\sigma < s$) and condition (11), while the second bracket is positive because of Assumption 4.

A.2 Data appendix

(INSERT TABLE 1 HERE)

TABLE 1: Characteristics of Crowdfunded Projects -- Summary Statistics and Survey Output

Panel A: Summary Statistics

Variables	Mean	Std. Dev.	Median	Min	Max	Nbr. Obs.
Funding Outcome:						
Total funds raised (in Euro) by the entrepreneur since the starting date of his crowdfunding process	3.5 million	15.0 million	28,583	36	82.1 million	33
Total funds expected initially (in Euro) from the crowdfunding process by entrepreneur	11.0 million	27.7 million	107,185	60	82.1 million	39
Crowdfunding Characteristics:						
(i) Donation: fraction of initiatives where crowd-funders make only donation without any kind of financial return or reward	0.220	0.418	0.000	0	1	50
(ii) Active Investment: fraction of initiatives where crowd-funders are involved in any way whatsoever in the venture or project they fund	0.320	0.471	0.000	0	1	50
(iii) Passive Investment: fraction of initiatives where crowd-funders are not involved in the venture or project they fund	0.600	0.495	1.000	0	1	50
Fraction of initiatives where if entrepreneur gives any kind of return or reward to crowd-funder, such as direct cash payment, shares/stocks, including dividends in the future, own product, getting a credit on the album, the DVD, or the Film, etc.	0.860	0.351	1.000	0	1	50
Fraction of initiatives where the goal of the initiative is making a product (conversely a service)	0.529	0.504	1	0	1	51
Date of Establishment and Start of Crowdfunding Initiative:						
Year at which the crowdfunding process started	2007.6	2.048	2008	2001	2009	36
Age (in years) of the firm at time the crowdfunding process started (i.e., since firm was established)	1.667	2.523	1.000	0	9	30
Fraction of crowdfunding initiatives that started in 2007 or later	0.806	0.401	1.000	0	1	36
Country of registration (Dummies):						
(i) Fraction with the registered office of entrepreneur located in USA	0.353	0.483	0.000	0	1	51
(ii) Fraction with the registered office of entrepreneur located in a European country	0.490	0.505	0.000	0	1	51
(iii) Fraction with the registered office of entrepreneur located elsewhere	0.157	0.367	0.000	0	1	51
Fraction with the registered office of entrepreneur located in an Anglo-Saxon country	0.588	0.497	1.000	0	1	51
Type of Organzational Form (Dummies):						
(i) Fraction of crowdfunding initiatives structured as a company	0.360	0.485	0.000	0	1	50
(ii) Fraction of initiatives where entrepreneur raised money by crowdfunding in connection with a specific project only	0.460	0.503	0.000	0	1	50
(iii) Fraction of initiatives where entrepreneur is working on behalf of a non-profit-making association	0.160	0.370	0.000	0	1	50
(iv) Fraction of initiatives where the entrepreneur acts as an individual (e.g., freelance)	0.020	0.141	0.000	0	1	50

Communiation methods used (Dummies):

(i)	Used blogs	0.689	0.468	1.000	0	1	45
(ii)	Used own Internet site	0.860	0.351	1.000	0	1	50
(iii)	Used the CV of founder(s)	0.106	0.312	0.000	0	1	47
(iv)	Used LinkedIn	0.111	0.318	0.000	0	1	45
(v)	Used Twitter	0.467	0.505	0.000	0	1	45
(vi)	Used MySpace	0.156	0.367	0.000	0	1	45
(vii)	Used Facebook	0.533	0.505	1.000	0	1	45
(viii)	Used other methods	0.48	0.51	0.000	0	1	46
Number of communication methods listed above used in connection with the crowdfunding initiative		3.956	1.954	4.000	1	8	45
Fraction of initiatives that used at least one of the following communication methods is used: Facebook, Twitter, blogs, LinkedIn, MySpace; these methods are characterized by facilitating social networking.		0.804	0.401	1.000	0	1	50

Type of Industries (Dummies):

(i)	Education	0.020	0.140	0	0	1	51
(ii)	Film/Music	0.216	0.415	0	0	1	51
(iii)	Finance	0.098	0.300	0	0	1	51
(iv)	Food/Restaurant	0.098	0.300	0	0	1	51
(v)	ICT	0.137	0.348	0	0	1	51
(vi)	Journalism	0.157	0.367	0	0	1	51
(vii)	Medical	0.020	0.140	0	0	1	51
(viii)	Politics	0.020	0.140	0	0	1	51
(ix)	Recycling	0.059	0.238	0	0	1	51
(x)	Sport	0.118	0.325	0	0	1	51
(xi)	Tourism	0.059	0.238	0	0	1	51

Panel B: Additional Statistics Based on Survey Output

Questions	Answers (%)	N
Number of founders:		
One founder only:	63.2%	19
Two founders exactly:	15.8%	19
Three founders exactly:	21.1%	19
Question: *"Do founders hold a university degree?"*		
Yes	70.0%	19
No	20.0%	19
Still attending university	10.0%	19
[Note: if more than one founder involved, we consider each founder separately.]		
Question: *"Do people (the "crowd") who invest in your company/project expect to receive return or reward from their investment?"*		
Yes	76.5%	17
No, they only make a donation	23.5%	17
Sub-question: *"If yes, what kind?"*		

Direct cash payment (other than dividends from shares)	22.2%	9
Shares/stock, including dividends in the future	33.3%	9
Right to receive own product	66.7%	9
Other	66.7%	9

Question: *"If you give investors shares, do you allocate voting rights to them?"*

Yes	18.2%	11
No	81.8%	11

Question: *"If other sources of finance than crowdfunding are used, please specify which one(s)."*

Bank loan	0.0%	9
Contributions from family and/or friends	18.8%	9
Business angel	18.8%	9
Founder's own money	25.0%	9
Government subsidy	18.8%	9
Other	43.8%	9

Question: *"Do you make use of a crowdfunding platform (e.g. Couch Tycoon)?"*

Yes	20.0%	15
No	80.0%	15

Question: *"What constitutes your main motivations for using crowdfunding?"* (Nbr. Obs. = 14 for all the three motivations provided to respondents and listed below.)

	High relevant	Relevant	Neutral	Somewhat relevant	Not relevant at all
Raise money	92.9%	7.1%	0.0%	0.0%	0.0%
Getting public attention for my company/project	64.3%	21.4%	7.1%	0.0%	7.1%
Validate my product/service before selling it (market survey)	35.7%	21.4%	7.1%	0.0%	35.7%

[Respondents could also cite other motivations; they are not listed here explicitly.]

Note: Information shown in Panel B was collected through the survey. To convert amount from other currency in euro, we computed an annual average rate (from 1/20/2009 to 1/20/2010) of the euro foreign exchange reference rates from the European Central Bank online statistics (available at: www.ecb.int).
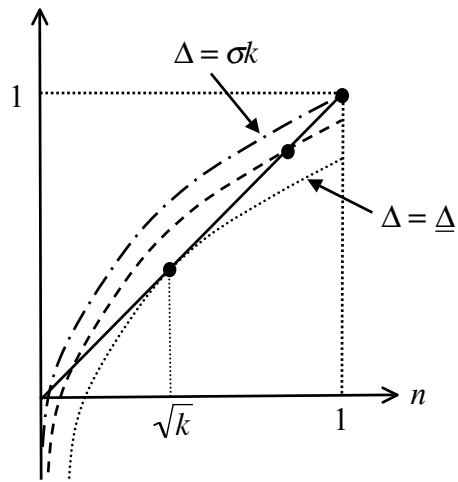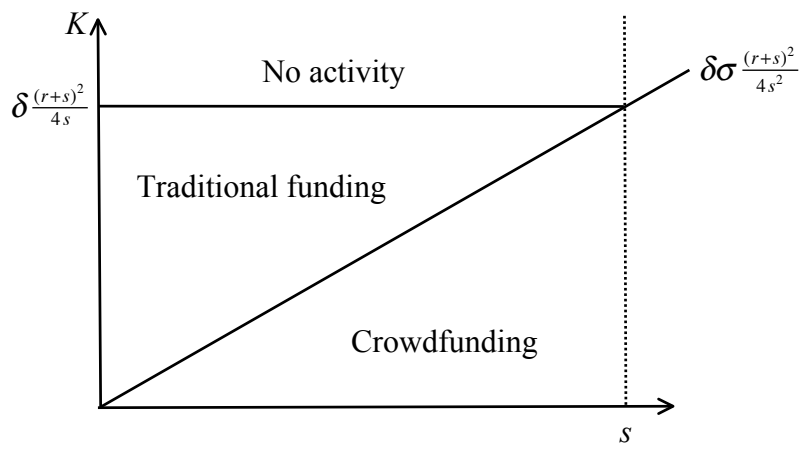
Figure 1. Fulfilled expectations equilibrium

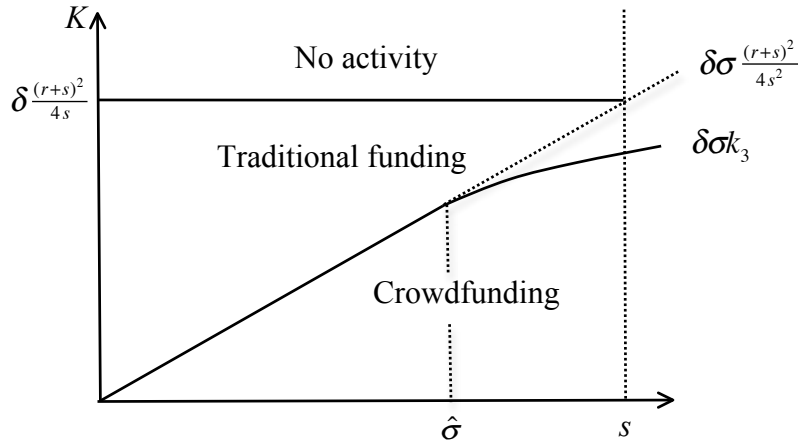Figure 2. Choice of funding method

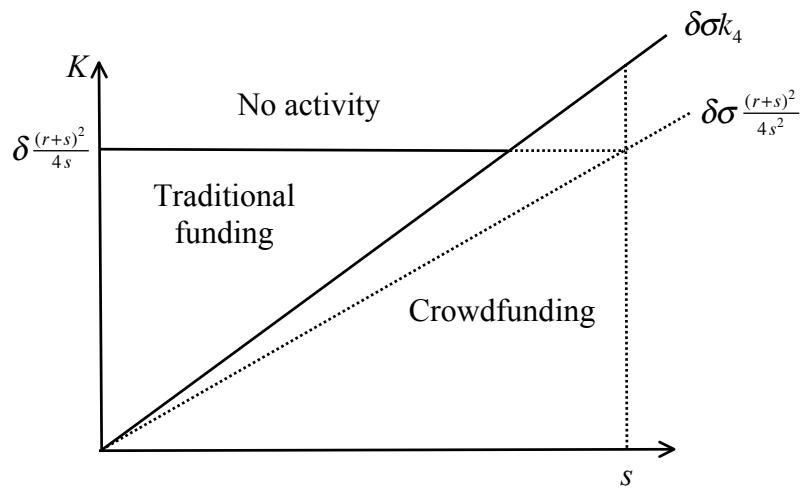Figure 3. Choice of funding method under the possibility of 'take the money and run'

Figure 4. Choice of funding method under alternative interpretations of σ