

Crowdfunding: Tapping the Right Crowd*

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Abstract

The basic idea of crowdfunding is for an entrepreneur to raise external finance from a large audience (the “crowd”), where each individual provides a very small amount, instead of soliciting a small group of sophisticated investors. The entrepreneur uses her social networks and established platforms on the Internet to directly interact with the crowd. The paper compares two different forms of crowdfunding: individuals are offered either to pre-order the product, or to advance a fixed amount of money in exchange for a share of future profits. In either case, “crowdfunders” are rewarded by “community benefits” that increase their utility. Using a unified model, we show that the entrepreneur prefers pre-ordering if the initial capital requirement is relatively small, and profit-sharing otherwise. Our conclusions have implications for managerial decisions in the early development stage of firms, since the entrepreneur needs to build a community of individuals with whom she must interact.

JEL classification codes: G32, L11, L13, L15, L21

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Introduction

It is well recognized that new firms face difficulties in attracting external finance at their very initial stage, be it through bank loans or equity capital (see, e.g., Berger and Udell, 1995, Cassar, 2004, and Cosh, Cumming and Hughes, 2009). Many entrepreneurial ventures remain unfunded, partially because of a lack of sufficient value that can be pledged to financial investors, partially because of unsuccessful attempts to convince investors (Shane and Cable, 2002; Hellmann, 2007; Kirsch, Goldfarb and Gera, 2009; Chen, Yao and Kotha, 2009; Casamatta and Haritchabalet, 2011). To circumvent these problems, creative founders have recently made use of a new source of finance—so-called crowdfunding—by tapping the “crowd” instead of specialized investors. This leads entrepreneurs to adopt new approaches of undertaking entrepreneurial projects and managing innovative ventures. This also results in new forms of business development where the “ordinary” crowd gets more closely involved in the decision-making process of these firms, either as active consumers or investors.

The concept of crowdfunding finds its root in the broader concept of crowdsourcing, which refers to using the crowd to obtain ideas, feedback and solutions in order to develop corporate activities (Howe, 2008; Kleemann, Voß and Rieder, 2008). 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. This can take the form of equity purchase, loan, donation or pre-ordering of the product to be produced.

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. Recently, *TikTok+LunaTik* raised \$941,718 from 13,512 individuals in the form of product pre-ordering of its multi-touch watch kit. Even more striking, consumers are currently pre-ordering watches from *Pebble* (a product of *E-Ink*) through *Kickstarter*; although pre-ordering is still possible until May 2012, the company has already collected more than \$5 million.

In this paper, we develop a model that allows us to compare two different forms of crowdfunding, which seem to dominate the scene nowadays (see the examples given in the next section). In the first form, consumers are invited to pre-order the product. For the entrepreneur to be able to launch production, the amount collected through pre-ordering must cover the required amount of capital. Since the remaining consumers will pay a different price when the product is on the market, 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 funding “crowd”) and the second group (the other “regular” consumers who wait that production takes place before purchasing directly). This form of crowdfunding appears thus as a special form of behavior-based price discrimination, since consumers self-select themselves in one of the groups based on their personal preferences. In the second form of crowdfunding, individuals are invited to provide money to the entrepreneur in exchange for a share of the profits or even to purchase equity securities issued by the entrepreneurial firm. These investors may or may not decide to become consumers in a later stage.

In both forms of crowdfunding, the participants to the crowdfunding mechanism, whom we refer to as “crowdfunders”, enjoy some additional

utility with respect to other, “regular”, consumers. As we illustrate with real-world examples in the next section, crowdfunding is most often associated with community-based experiences that generate “community benefits” for their participants.¹ In accordance with empirical observations, we assume that the nature of these community benefits varies with the form of crowdfunding: community benefits are linked to the consumption experience under a pre-ordering mechanism, and to the investment experience under a profit-sharing mechanism.

This difference proves crucial when it comes to comparing the two mechanisms from the point of view of the entrepreneur. Our main result is indeed to show that, in general, the entrepreneur prefers the pre-ordering mechanism when the initial capital requirement is relatively small, and the profit-sharing mechanism for larger capital amounts. The intuition behind this result is the following. When the capital requirement is small, it poses no constraint for the entrepreneur when price discriminating between crowdfunders who pre-order and regular consumers. Those who enjoy higher utility from consuming the good will be ready to pay more to secure additional community benefits arising from crowdfunding compared to other consumers, who will wait that the product is offered on the market at a lower price. Through price discrimination, the entrepreneur can extract some of the community benefits from crowdfunders through this discriminatory price setting. When the amount of capital needed becomes large, the entrepreneur is, however, forced to distort her optimal pricing scheme in order to attract more people to pre-order; otherwise, she may not be able to raise enough money to begin with. The larger this distortion, the smaller are the gains from opting for

¹In this respect, see, e.g., Jeppesen and Frederiksen (2006), whose work examines innovative users’ motivations in firm-hosted user communities. In particular, the authors show that users’ motivations for participation and innovation in community are related to their desire to be recognized by the firm.

pre-ordering.

This contrasts with crowdfunding through profit sharing, where the benefits are higher when capital requirements are large. For larger capital requirements, it becomes preferable to have the upfront investment financed through investors' contributions rather than through pre-sales of the product, even if fewer individuals end up buying the product. This is because, under our assumptions, individuals are heterogeneous with respect to community benefits under pre-ordering, but homogeneous under profit-sharing. The practical implication of this difference is that the entrepreneur can more easily tax community benefits away with profit-sharing than with pre-ordering. As such, the entrepreneur again can price discriminate between individuals since the most eager consumers will end up financing the entrepreneur to make sure production of the good takes place.

Interestingly, in some cases crowdfunding in the profit-sharing mechanism resembles donations, a form of financing not unusual in connection with crowdfunding (see, for instance, donation-based platforms such as *Crowdfunding Facilities*). Our analysis offers insights into when donations may become a viable form of crowdfunding. When donators expect to become future consumers and community benefits are large, individuals may support a project by donating money so that the entrepreneur can carry her project forward. These findings contrast with earlier intuitions on donation-based entrepreneurship that requires not-for-profit organizations as only sustainable organizational structure to access donations (Glaeser and Shleifer, 2001), such as *National Geographic*, the *Red Cross* and *Médecins Sans Frontières*. In the existing literature, donations arise because individuals are assumed to be altruistic. In our case, crowdfunders donate because they expect to be consumers.

Our study has interesting implications for theory and practice of business venturing. We complement the growing literature on the participation of firms in online communities. Miller, Fabian and Lin (2009) show that firms can benefit by making some individuals promoters of their new products. In our context, we show that crowdfunding can generate advantages compared to traditional funding since price discrimination allows expanding the market. This may help certain types of entrepreneurs to achieve strategic advantages for their subsequent development by attaining higher growth trajectory early. Our conclusions also shed light into the social environment needed to make crowdfunding a viable alternative. Building a community that supports the entrepreneur is a critical ingredient to make crowdfunding more profitable than traditional funding. In the absence of such non-monetary benefits, price discrimination is not possible and thus both forms of crowdfunding yield exactly the same outcome as seeking money from a bank or an equity investor. At the same time, building such a community or attracting the crowd strongly influences the strategic decision-making process in the early stage of business development. This requires integrating social networks, especially making use of the Internet, in the managerial process as a mean to interact with the crowd. As will become clear below, in some cases the crowd is directly involved in some strategic decisions concerning product design and the exact nature of the product to be offered. We therefore contribute also to the managerial literature on strategic ties' formation by entrepreneurs as a mean to obtain resources, either financial or with an innovative content (see, e.g., Hallen and Eisenhardt, 2012). Under crowdfunding, entrepreneurs form ties with the "crowd" for strategic purposes of raising money. Regardless of the type of crowdfunding chosen (pre-ordering or profit-sharing), ties formation with the crowd can be con-

sidered critical to achieve superior outcomes in terms of profit compared to traditional financing or as a way to obtain financing when traditional sources are not available.

The remaining of this paper is structured as follows. We first offer a definition of crowdfunding, discuss crowdfunding practices and provide a survey of related literature. Then, we present the model and discuss its results and implications. Finally, we conclude with suggested topics for future research.

What is crowdfunding?

Our objective in this section is twofold. First, we aim at providing a general definition of crowdfunding. Second, we discuss how crowdfunding affects the way entrepreneurs use their social networks to raise money. To this end, we present selected crowdfunding initiatives and then provide a review of the related literature.

A definition

As mentioned in the Introduction, the concept of crowdfunding can be seen as part of the broader concept of crowdsourcing, which refers to using the “crowd” to obtain ideas, feedback and solutions in order to develop corporate activities.² Kleemann, Voß and Rieder (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

²The term “crowdsourcing” has been first used by Jeff Howe and Mark Robinson in the June 2006 issue of Wired Magazine (Howe, 2008).

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.

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 (see Larralde and Schwienbacher, 2010, and Griffin, 2012, for an extended discussion). 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. For instance, in the *Seedmatch* project, the crowd finances an investment vehicle that then buys shares in the company. Others offer profit sharing mechanisms in which the crowd receives a pre-specified fraction of profits from the sale of the product for their investment (for instance, cartoon projects offered on the platform *Sandawe*).

Besides, while the Web 2.0 has been a critical ingredient in the development of crowdfunding practices, it also differs from open-source practices (Brabham, 2008; Fershtman and Gandal, 2011). An important distinction is that in the case of open-source, the resource belongs to the community, which can then exploit it on an individual basis (there is no restriction on who can use it); in the case of crowdfunding (and also crowdsourcing), it ultimately belongs to the firm, which will be the only one to use 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.

Based on this discussion and in the spirit of Kleemann, Voß and Rieder (2008), we offer the following, refined definition. *Crowdfunding involves an open call, mostly through the Internet, for the provision of financial resources either in form of donation or in exchange for the future product or some form of reward and/or voting rights.*

As mentioned above, the promised reward can be monetary or non-monetary (such as recognition). This definition encompasses many forms of crowdfunding practices. In this paper, we focus on two forms of crowdfunding initiatives, which tend to become prevalent nowadays: one takes the form of pre-ordering of products; the other of profit-sharing. The following section provides real-case examples of both forms.

Examples

Different reasons may explain recent successes of entrepreneurs who have relied on crowdfunding. Also, there exist many ways to “crowdfund” a project. However, crowdfunding initiatives share some common characteristics, which we stress below in the light of selected cases.

In 2005, the South African singer *Verity Price* launched the “*Lucky Packet Project*”. To record her album without assistance of a record label, Verity Price needed to advance an up-front investment of ZAR300,000.³ To this end, she set up a website where she asked people to pre-purchase her album at ZAR150 before she recorded it. In return from their contributions, people were compensated with some form of non-monetary rewards, such as their name credited on her website, the possibility to vote on which songs are

³ZAR (South African Rands) 300,000 is approximately €27,000.

recorded, and what artwork and photography are used for the album. Also, 10% of sales would be transferred to charities. Verity Price managed to reach the threshold of ZAR300,000 with the contributions of 2061 individuals. Then, she used the money to record her album. Now, the album has been put on the market and is sold to everyone at ZAR116.

In the same vein, the *LINCH three Project* aims at making a documentary film about the artist David Lynch. The filmmakers ask to David Lynch's fans to donate \$50 each to fund the film project. The fans' community are rewarded by having online access to exclusive content on the filmmaking process and by receiving limited edition of footage created by Lynch himself either into print, T-shirt, or bag. Once the money is raised, the documentary film will be produced and distributed via the regular distribution channels.

Although the British crowdfunded film "*The Age of Stupid*" offered similar rewards to some crowdfunders, other crowdfunders also receive some of the profits. Indeed, crowdfunders saw their name credited on the website and DVD or received a pro-rata share in the net profits from the film, if their contribution exceeded £5,000. Altogether, 258 crowdfunders invested in the film.⁴

As exemplified by these cases, crowdfunding seems popular in the entertainment industry. However, entrepreneurial ventures in other industries have been financed in the same way and share similar characteristics. Initiatives have been undertaken in other industries such as journalism (*Spot.Us*), beer (*BeerBankroll*), software (*Blender Foundation*), tourism (*MediaNoMad*), and sports. Regarding the latter sector, the case of *MyFootballClub* (who own the football club *Ebbsfleet United* in the United Kingdom)

⁴The percentage of net profits went from .05% to 1%. Individuals who could not raise the necessary cash themselves (i.e., £5,000) could form syndicates by clubbing together. In this instance one named individual bought the 'share' and the syndicate made contract between their members to formally detail an agreement.

is quite interesting. The contribution of fans (a membership fee of £35) allowed them to complete the takeover of the club and form a community with real decision power (members are involved in the management of the club through their voting right). Another compelling example is *Trampoline Systems*, a London-based technology company, which led a crowdfunding campaign in 2009 to expand the business. *Trampoline Systems* raised equity capital from 100 sophisticated investors (the crowdfunders) with a minimum stake of £10,000. The online community experience between investors allowed crowdfunders to enjoy additional rewards beside purely financial return from their investment.

Other examples of profit sharing are *Seedmatch* and *Sandawe*. The first offers the crowd to invest in a financial vehicle that then buys shares in startups who aim at attracting the crowd as equity investors. Several entrepreneurial firms have already been successful in launching their crowdfunding initiative on *Seedmatch*, often raising up to €100,000 within a few days from 80 to 160 individual investors. Next to earning money on their investment, participants can interact with company founders and receive updated information on the firms' most recent developments so that they feel belonging to a community of investors. In the case of *Sandawe*, the crowd can view a few pages of proposed comic books and decide to finance it. For each project, *Sandawe* calculates a budget that is needed to support production and launching expenses (generally in the range between €35,000 and €55,000 for an album). A project gets financed by *Sandawe* only when this budget is achieved. Crowdfunders participate directly in the benefits of the book project being financed without holding shares. They first receive 60% of net gains from sales until they have received their initial investment, then only 40% of any remaining net gains. This splitting rule applies to

any income received from the commercialization of the album during the first five years. Since crowdfunders are mostly comic book fans, they may enjoy non-monetary benefits related to the fact that they contributed to the realization of the book through their investment.

To sum up, these cases highlight three recurrent characteristics: *(i)* the pre-ordering of the product, *(ii)* the high willingness to pay of crowdfunders, *(iii)* the nature of community benefits. First, crowdfunding initiatives often rely on advance purchase of a product, which is not yet on the market in its finished form. At the pre-ordering stage, the entrepreneur offers just a description and promise on what the final product will be, and also commits that the product will indeed be put on the market. Second, in most of the cases, consumers who pre-order the product pay more than the regular consumers, who wait that production takes place before purchasing directly. In the Verity Price's experience, the regular consumers pay ZAR116 whereas the pre-ordering consumers pay ZAR150. The crowdfunders are therefore willing to pay more for the product. Third, the crowd must identify themselves as such. Crowdfunders must feel that they are being part of a community of "special" or "privileged" consumers/investors. This community enjoys benefits associated either with consumption, or with investment. Community benefits derived from consumption are, in the *LINCH three Project*, access to exclusive footage of David Lynch, or, in the case of *MyFootballClub*, the management of *Ebbsfleet United*. Community benefits stemming from the investment experience may also take different forms, from non-monetary rewards (names credited on the website with *The Age of Stupid*, or investors' online meetings with *Trampoline Systems*) to profit sharing (direct cash payment, dividends, or capital gains from equity investments). Hence, consumers/investors may self-select into this community

and entrepreneurs ensure that consumers/investors enjoy such community benefits and build trust in the project.

Literature on crowdfunding

As crowdfunding is a relatively new phenomenon, it is no surprise that the literature specifically devoted to crowdfunding is only nascent. However, it is worthwhile making parallels with other sources of entrepreneurial finance. This allows us to better understand the specificities of crowdfunding as a distinct form of finance.

First, looking at crowdfunding from a pure financial perspective, connections can be made with bootstrap finance. This form of financing consists of using internal financing ways rather than traditional sources of external finance (e.g., bank loan, angel capital and venture capital). Several studies provide evidence of the different forms of internal sources 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, Cumming and Hughes (2009), who examine a broader range of financing alternatives. None of these studies however consider the “crowd” as possible alternative (regardless of whether it is made of potential consumers or of simply profit-driven individuals).

Agrawal, Catalini and Goldfarb (2011) focus on crowdfunding more specifically. They examine the geographic origin of consumers who invest on the *SellaBand* platform.⁵ The authors observe that “the average distance

⁵*SellaBand* is an online platform based in Amsterdam that enables musicians to raise money to produce their album. *SellaBand*'s business model is as follows. Artists can post a number of songs (demos) on the platform; visitors to the site can then listen to the music for free and choose the artists they want to invest in; artists seek to raise \$50,000 by

between artist-entrepreneurs and investors is about 3,000 miles, suggesting 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 geography of crowdfunding is also studied by Mollick (2012), who uses data from *Kickstarter* (the largest crowdfunding platform at this date) to examine the determinants of success in crowdfunding ventures. The author uncovers “a strong geographic component to the nature of projects, with founders proposing projects that reflect the underlying cultural products of their geographic area.”

When crowdfunding is associated with pre-ordering and price discrimination, some strand of literature in the realm of industrial organization provides useful insight. Nocke, Peitz and Rosar (2011) have recently linked product pre-ordering to price discrimination, however in a context of information asymmetry.⁶ There, the true quality of the product is revealed later so that the firm faces consumers with different expected valuations for its forthcoming product. This induces consumers with highest expected valuation to pre-order before the quality is known. Advance-purchase then leads to price discounts, in contrast to our setting that abstracts from information asymmetry. Parallels can also be made between our model of pre-ordering and models of behavior-based price discrimination.⁷ One main difference

selling “Parts” at \$10 each; during the fundraising stage, money is held in an escrow until the threshold of \$50,000 is reached. The \$50,000 will be used to fund the artist’s recording project; finally investors (the “Believers”) are compensated by receiving 10% of revenue from the album. *SellaBand* has been one of the first website of this kind; followers are, e.g., *MyMajorCompany* in France, *Akamusic* in Belgium, and *ArtistShare* in the United States.

⁶Other studies have shown that advance-purchase discounts may arise in environments where production capacity is limited or the aggregate level of demand is uncertain (Gale and Holmes, 1992, 1993; Dana, 1998, 1999, 2001).

⁷See Fudenberg and Villas-Boas (2007) or Armstrong (2007) for a review. See Belleflamme and Peitz (2010, Section 10.3) for a textbook treatment.

with this literature is that crowdfunding requires that first-period profits be above some minimum level.

A unified model with two crowdfunding forms

We consider an entrepreneur who wants to launch a new product. A precondition to launch this product is to collect an amount of capital equal to K . For unmodelled reasons, the entrepreneur has not been successful in attracting sufficient external finance to cover this amount. She therefore intends to “tap the crowd”. Table 1 summarizes the various variables used in what follows.

As our focus is on the relative performance of two crowdfunding mechanisms, we simplify the modelling of the product market by assuming (i) that the entrepreneur enjoys a monopoly position and (ii) that consumers know the characteristics of the products before purchase. The former assumption does not seem too restrictive insofar as the examples given in the previous section suggest that crowdfunding initiatives mainly appear on niche markets (which can be approximated as local monopolies). The latter assumption, on the other hand, could be seen as more restrictive as anecdotal evidence suggests that entrepreneurs may use web-based crowdfunding to reveal information about the product and, thereby, alleviate the experience good problem.⁸ We choose to ignore this possibility here (but we discuss it in the concluding section).

The “crowd” that the entrepreneur can solicit for financing her project is made of a unit mass of individuals. These individuals are identified by θ , with θ uniformly distributed on $[0, 1]$ and have unit demand (they buy

⁸Nelson (1970) contrasts *experience* goods (whose value can only be ascertained by consuming them) with *search* goods (whose characteristics and features are easily evaluated before purchase).

one or zero unit of the product). An individual of type θ derives surplus $U = \theta s - p$ when consuming a product of quality s sold at price p . The parameter θ is a taste parameter that measures the marginal utility of an increase in product's quality.⁹ Here, we take quality s as given and known by all parties.

To induce some consumers to finance the initial capital, the entrepreneur can choose between two different crowdfunding mechanisms: consumers are offered either to pre-order the product, or to advance a fixed amount of money in exchange to a share of future profits. In both cases, it is assumed that the consumers who participate to the crowdfunding mechanism—whom we refer to as “crowdfunders”—enjoy some additional utility. We have indeed observed above that entrepreneurs resorting to crowdfunding use the Internet to maintain an interaction with their funders so as to provide them with so-called “community benefits”.

However, it seems reasonable to assume that the nature of these community benefits differ in the two cases. When crowdfunding is based on pre-ordering, community benefits stem directly from the consumption experience. For instance, in the *Verity Price* example, crowdfunders can vote on which songs are on the album and what artwork is used; in the *LINCH three Project*, crowdfunders have online access to exclusive content. We model this by assuming that crowdfunders perceive an increase in the product quality. Community benefits therefore increase the crowdfunders' utility in proportion to their taste parameter: a consumer who values more the product will also value more the enhanced consumption experience that crowdfunding provides.

In contrast, when crowdfunding is based on profit sharing, community

⁹This problem was initially examined by Mussa and Rosen (1978).

benefits are more related to investment than to consumption. Participating in crowdfunding is through investment, and the crowd can support the firm without necessarily becoming a consumer. Crowdfunders enjoy an increase in utility because they value the feeling of belonging to a group of “special” or “privileged” individuals (those individuals who contributed to the very existence of the product!). We gave above the example of *Trampoline Systems*, which organizes regular online meetings with its crowdfunders. Here, there is no reason to make community benefits depend on the identity of the consumers: all crowdfunders enjoy the same increase in utility, irrespective of their taste parameter. We summarize our assumptions as follows.

Assumption 1. *With crowdfunding, the entrepreneur create community benefits that increase, in a separable way, the utility of crowdfunders. When crowdfunding is based on pre-ordering, crowdfunders perceive the quality of the product to be equal to $s + \sigma$, with $\sigma > 0$; the additional utility for a crowdfunder of type θ is thus $\theta\sigma$. When crowdfunding is based on profit sharing, the additional utility for any crowdfunder is $\Sigma > 0$.*

We now consider the two crowdfunding mechanisms in turn and we then proceed to a comparison, taking the point of view of the entrepreneur.

Crowdfunding and pre-ordering

In this section, we focus on crowdfunding experiences where consumers are invited to pre-order the product. For the entrepreneur to be able to launch production, the amount collected through pre-ordering must cover the required capital K . 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, an entrepreneur is generally unable to identify these consumers. The entrepreneur 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 entrepreneur enhances the perceived quality of the product for the consumers who agree to pre-order it. In this sense, crowdfunding appears as a special form of behavior-based price discrimination.

The timing of the game is as follows. In the first period, the entrepreneur sets the pre-ordering price p_c (with subscript c for “crowdfunders”) and consumers decide whether or not to pre-order at that price. Let n_c denote the mass of crowdfunders (i.e., of consumers who decide to pre-order). If $n_c p_c < K$, insufficient capital has been collected and the game stops. The crowd then receives its money back. Otherwise, if $n_c p_c \geq K$, the game moves to the second period where the entrepreneur sets p_r , the price for consumers who did not pre-order in period 1 (with subscript r for “regular consumers”). Those consumers then decide to buy or not (observing all the previous steps). Note that this timing supposes that the entrepreneur is not able to commit to the second-period price p_r in period 1. This seems reasonable as the very existence of the product is itself uncertain in period 1.¹⁰ Utilities and profits accrue at the end of period 2. Without loss of generality, we assume no discounting and we normalize $s = 1$. We solve the game backward for its subgame-perfect Nash equilibrium.

Period 2. Suppose that $n_c \in (0, 1)$ consumers pre-ordered in period 1 and that $n_c p_c \geq K$. Then the indifferent consumer between pre-ordering and not is identified by a taste parameter $\theta_c = 1 - n_c$. Consumers who can potentially buy the product at period 2 are such that $\theta \in [0, \theta_c]$. Facing p_r , they buy iff $\theta - p_r \geq 0$, or $\theta \geq p_r \equiv \theta_r$. Hence, assuming for simplicity zero

¹⁰As will become apparent below, the ability or not to commit to the period 2 price proves crucial when comparing the two crowdfunding mechanisms.

marginal cost of production,¹¹ the entrepreneur faces the following program at period 2: $\max_{p_r} p_r (\theta_c - p_r)$. The optimal price and second-period profit are easily found as

$$p_r(\theta_c) = \frac{\theta_c}{2}, \quad (1)$$

$$\pi_2(\theta_c) = \frac{\theta_c^2}{4}. \quad (2)$$

Period 1. The indifferent consumer between pre-ordering and not is identified by θ_c such that: $\theta_c(1 + \sigma) - p_c = \theta_c - p_r$ or $\theta_c = (p_c - p_r)/\sigma$. In period 1, consumers observe the value of p_c and are able to anticipate that the entrepreneur will set in period 2 the value of p_r given in expression (1). We have thus

$$\theta_c = \frac{1}{\sigma} \left(p_c - \frac{\theta_c}{2} \right) \Leftrightarrow \theta_c = \frac{2p_c}{1 + 2\sigma}.$$

We can then write the entrepreneur's maximization program in period 1 as

$$\max_{p_c} p_c \left(1 - \frac{2p_c}{1 + 2\sigma} \right) + \frac{1}{4} \left(\frac{2p_c}{1 + 2\sigma} \right)^2,$$

under the following constraints

$$\begin{aligned} \pi_1 &\equiv p_c \left(1 - \frac{2p_c}{1 + 2\sigma} \right) \geq K, \\ 0 &\leq \frac{2p_c}{1 + 2\sigma} \leq 1. \end{aligned}$$

The unconstrained optimum is given by the first-order condition:

$$p_c^* = \frac{(1 + 2\sigma)^2}{2(1 + 4\sigma)}. \quad (3)$$

¹¹In this linear model, this assumption is made without loss of generality. Prices can simply be reinterpreted as markups above a constant marginal cost.

The first constraint is satisfied if $\pi_1 \geq K$, which can be rewritten as

$$K \leq \frac{\sigma(1+2\sigma)^2}{(1+4\sigma)^2} \equiv \bar{K}.$$

As for the second set of constraints, we compute

$$\theta_c^* = \frac{2p_c}{1+2\sigma} = \frac{1+2\sigma}{1+4\sigma}. \quad (4)$$

This value is clearly positive and smaller than unity; the second set of constraints is thus satisfied.

Unconstrained case. If $K \leq \bar{K}$, we can plug (4) into (1) and (2) to compute

$$p_r^* = \frac{1+2\sigma}{2(1+4\sigma)}, \text{ and } \pi_2^* = \frac{(1+2\sigma)^2}{4(1+4\sigma)^2}.$$

The total profit at the unconstrained optimum is thus equal to

$$\Pi^* = \pi_1^* + \pi_2^* - K = \frac{(1+2\sigma)^2}{4(1+4\sigma)} - K.$$

Before considering the constrained case, it is useful to compare the results in the unconstrained case to two useful benchmarks. First, to appreciate the effect of price discrimination, we can compare the prices p_c^* and p_r^* with the uniform price that the entrepreneur would set were she not able to price discriminate. Denoting by p_u this uniform price, the indifferent consumer would be such that $\theta - p_u = 0$. The entrepreneur would then choose p_u to maximize $p_u(1 - p_u)$. Consequently, the entrepreneur would set $p_u = 1/2$, all consumers with $\theta \geq 1/2$ would purchase the product, and gross profits would be equal to $1/4$.

Comparing the pre-ordering scheme with uniform pricing, we easily check

that crowdfunders pay a larger price ($p_c^* > p_u$) while regular consumers get the product at a discount ($p_r^* < p_u$). The pre-ordering scheme also expands the market: the marginal consumer is indeed identified by $\theta_r^* = (1 + 2\sigma) / (2(1 + 4\sigma)) < 1/2$. Putting everything together, we observe that the pre-ordering scheme allows the entrepreneur to increase profits with respect to uniform pricing:

$$\Pi^* = \frac{(1 + 2\sigma)^2}{4(1 + 4\sigma)} - K = \frac{1}{4} + \frac{\sigma^2}{1 + 4\sigma} - K > \frac{1}{4} - K.$$

A second benchmark is the case where the entrepreneur would be able to commit in period 1 to the price that prevails in period 2. The entrepreneur's maximization program in period 1 would then be given by

$$\max_{p_c, p_r} \left(1 - \frac{p_c - p_r}{\sigma}\right) p_c + \left(\frac{p_c - p_r}{\sigma} - p_r\right) p_r \quad \text{s.t.} \quad 1 \geq \frac{p_c - p_r}{\sigma} \geq p_r \geq 0.$$

It can be checked that the optimal prices would then be $p_c = (1 + \sigma) / 2$ and $p_r = 1/2$. At these prices, $(p_c - p_r) / \sigma = p_r$, meaning that no individual finds it profitable to buy the product in period 2 (thereby foregoing the community benefits σ). In other words, when the entrepreneur can commit to the period 2 price, she optimally chooses not to open the market in period 2.¹² She then only attracts crowdfunders, who are willing to pay $\theta(1 + \sigma)$ for the product. The corresponding profit is computed as $(1 + \sigma) / 4 - K$, which is easily seen to be larger than Π^* . This result that the entrepreneur is hurt by her inability to commit to future prices is also observed in settings with durable goods or with behavior-based price discrimination.

¹²This is a standard result about second-degree price discrimination. Salant (1989) shows that when utilities and costs are linear, a monopolist prefers to offer a single version of its product, refraining thus from price discrimination.

Constrained case. If $K > \bar{K}$, then the unconstrained optimal price and number of crowdfunders are insufficient to cover the capital requirement. Then p_c is computed as the solution to $\pi_1 = K$, i.e.,

$$p_c \left(1 - \frac{2p_c}{1+2\sigma} \right) = K \Leftrightarrow 2p_c^2 - (1+2\sigma)p_c + (1+2\sigma)K = 0.$$

For this polynomial to have real roots, we need $K < (1+2\sigma)/8 \equiv \hat{K}$. Put differently, there is a threshold for the initial capital requirement above which the entrepreneur is unable to finance her venture through crowdfunding and pre-ordering.

If $K < \hat{K}$, the two roots are

$$\begin{cases} p_c^+ = \frac{1}{4} \left(1 + 2\sigma + \sqrt{(1+2\sigma)(1+2\sigma-8K)} \right), \\ p_c^- = \frac{1}{4} \left(1 + 2\sigma - \sqrt{(1+2\sigma)(1+2\sigma-8K)} \right). \end{cases}$$

Recall that we also need $0 \leq \theta_c \leq 1$, which is equivalent to $0 \leq p_c \leq (1+2\sigma)/2$. We find that $0 < p_c^- < p_c^+ < (1+2\sigma)/2$. Although the two values of p_c are equivalent to reach the required profit in the first period, the entrepreneur prefers the largest price as the second period profit increases with p_c . The firm sets thus

$$\bar{p}_c = \frac{1}{4} \left(1 + 2\sigma + \sqrt{(1+2\sigma)(1+2\sigma-8K)} \right). \quad (5)$$

Comparing the latter value with the unconstrained price given in (3), we can check that $K > \bar{K}$ implies that $\bar{p}_c < p_c^*$. That is, the entrepreneur is constrained to charge a lower price to crowdfunders. She therefore compensates by attracting more of them: the size of the population of crowdfunders increases with the amount that has to be funded.

It follows that $\bar{\pi}_1 = K$, while $\bar{\pi}_2$ (which is equal to the total profit $\bar{\Pi}$) is

computed as

$$\bar{\Pi} = \bar{\pi}_2 = \left(\frac{\bar{p}_c}{1 + 2\sigma} \right)^2 = \frac{1}{16} \left(1 + \sqrt{1 - \frac{8K}{1 + 2\sigma}} \right)^2.$$

Clearly, when K is large enough, the latter profit goes below what the entrepreneur would earn if she could finance her venture in the traditional way and sell the good at a uniform price. We check indeed that for $K = \hat{K}$ (i.e., the largest amount of capital that can be financed through pre-ordering), $\bar{\Pi} = 1/16 - K < 1/4 - K$. This illustrates the ins and outs of crowdfunding based on pre-ordering with respect to more traditional funding sources. On the one hand, crowdfunding has the advantage of offering an enhanced experience to some consumers and, thereby, of allowing the entrepreneur to practice a form of behaviour-based price discrimination, which has the potential to increase profits by extracting a larger share of the consumer surplus. On the other hand, the disadvantage is that the entrepreneur is constrained in the first period by the amount of capital that she needs to raise. This distorts the price discrimination strategy of the entrepreneur. The larger this amount, the larger the number of consumers that have to be attracted to cover it, which eventually reduces the profitability of the pre-ordering scheme.

Collecting our previous results, we can state:

Lemma 1 *The entrepreneur's profit under crowdfunding/pre-ordering is*

equal to

$$\Pi_p = \begin{cases} \frac{1}{4} + \frac{\sigma^2}{1+4\sigma} - K & \text{for } K \leq \bar{K}, \\ \frac{1}{16} \left(1 + \sqrt{1 - \frac{8K}{1+2\sigma}}\right)^2 & \text{for } \bar{K} \leq K < \hat{K}, \\ 0 & \text{for } \hat{K} \leq K, \end{cases} \quad (6)$$

with $\bar{K} = \frac{\sigma(1+2\sigma)^2}{(1+4\sigma)^2}$ and $\hat{K} = \frac{1+2\sigma}{8}$.

It is intuitive, and clear from expression (6), that the entrepreneur's profit decreases with the amount of capital that has to be raised (K). It can also readily be checked that the profit increases with the magnitude of the community benefits (σ). There are two reasons for this. First, an increase in σ raises the surplus of crowdfunders, which can be partially captured by the entrepreneur. Second, the constraint imposed by the capital requirement becomes relatively less stringent as σ increases: the difference $\hat{K} - \bar{K}$ is a decreasing function of σ .

Crowdfunding and profit-sharing

We turn now to a different crowdfunding mechanism whereby consumers are invited to provide money to the entrepreneur in exchange for a share of the profits. In this case, financing and consumption decisions are not automatically related: individuals may decide to invest but not consume, or vice versa. As explained above, crowdfunders still enjoy some extra utility from participating in the crowdfunding mechanism but these community benefits are now detached from the consumption of the product. In particular, crowdfunders enjoy benefits through their investments decisions and thus see their utility increased by Σ irrespective of their taste for product quality.

The timing of the game is now as follows. In period 1, the entrepreneur

sets the share α of her profits that she will distribute to crowdfunders (with $0 \leq \alpha < 1$); consumers decide then whether to become crowdfunders or not. In period 2, the entrepreneur sets the price of the product and consumers decide whether to buy the product or not. As in the previous section, we assume that utilities and profits accrue at the end of period 2 and that there is no discounting. We solve the game backward for its subgame-perfect Nash equilibrium.

Period 2. With this crowdfunding mechanism, the investment decision no longer affects the consumers' valuation of the product, since Σ is linked to investment and not consumption. The entrepreneur's maximization problem in period 2 is therefore the uniform-pricing problem that we described above. We recall that the demand function is simply $D(p) = 1 - p$. The profit-maximization price is thus $p = 1/2$ and the corresponding profit is $\pi = 1/4$. At price $p = 1/2$, consumers with $\theta \in [1/2, 1]$ buy the product and consumers with $\theta \in [0, 1/2)$ do not buy.

Note that under the profit-sharing mechanism, the entrepreneur no longer faces the commitment problem that we identified under the pre-ordering mechanism. Here, it is clear for all individuals from the outset that the product market will only be open in period 2.

Period 1. To determine whether consumers are willing to invest or not, we need to distinguish between the consumers who decide to buy the product in period 2 and those who do not. For those who buy, i.e., the consumers with $\theta \in [1/2, 1]$, the incentive constraint for investing is

$$\theta - \frac{1}{2} + \frac{\alpha}{n_c} \frac{1}{4} - \frac{K}{n_c} + \Sigma \geq 0.$$

On the LHS, the first two terms are the net utility from consuming the product, the second term is the share of profits that the crowdfunder receives (where n_c denotes the number of crowdfunders), the fourth term is the money that the crowdfunder is asked to advance to the entrepreneur (which decreases with the number of crowdfunders as the capital requirement K can be split among a larger crowd), and the fifth term is the community benefits that accrue to crowdfunders. The outside option, on the RHS, is set to zero. This corresponds to the idea that consumers form the belief that if they do not invest, the product will not be launched; in other words, each investor assumes that he is pivotal. As we will see below, such beliefs are consistent as the entrepreneur will always choose the value of α that will restrict the number of individuals n_c in such a way that the participation of each of them is needed to raise the amount K . Therefore, every individual becomes pivotal. In equilibrium, the selected individuals will be the ones with highest θ .

We can then identify the marginal investor as the consumer for whom the previous equation holds with equality:

$$\theta_i = \frac{1}{2} - \left(\frac{\alpha}{n_c} \frac{1}{4} - \frac{K}{n_c} + \Sigma \right). \quad (7)$$

We note that $\theta_i > 1/2$ if and only if the net utility from investing is negative:

$$\frac{\alpha}{n_c} \frac{1}{4} - \frac{K}{n_c} + \Sigma < 0.$$

As for the individuals who do not buy in period 2, i.e., those with $\theta \in [0, 1/2)$, the incentive constraint for investing is simply

$$\frac{\alpha}{n_c} \frac{1}{4} - \frac{K}{n_c} + \Sigma \geq 0. \quad (8)$$

Here, the outside option (RHS of the condition) is simply equal to zero.

The entrepreneur has thus the choice between two options. She can either set α in such a way that constraint (8) is satisfied, thereby making the investment attractive in itself for all individuals. In that case, the entrepreneur can turn all individuals into investors (i.e., raise n_c up to 1) if it is profitable to do so. The alternative option is to violate constraint (8) and make the investment only profitable for those buying consumers with a high valuation for the product ($\theta \geq \theta_i$): even though the investment is not profitable in itself, these consumers are willing to accept losses from their first-period investment to make sure that the product will be launched. We consider the two options in turn.

1. *Large base of crowdfunders.* In the first option, the entrepreneur chooses the lowest α that satisfies the incentive constraint (8):

$$\alpha_{(1)} = 4K - 4n_c\Sigma.$$

She then chooses n_c so as to maximize her residual profit, which is equal to $\Pi = (1 - \alpha_{(1)}) (1/4)$, subject to $0 \leq \alpha_{(1)} < 1$.¹³ It is easily seen that the residual profit increases with n_c (since $\alpha_{(1)}$ decreases with n_c). The unconstrained optimum is then to set $n_c = 1$. The corresponding share of distributed profit is then equal to $\alpha_{(1)} = 4(K - \Sigma)$.

There are three possible cases. First, if $K \geq 1/4 + \Sigma$, the entrepreneur is not able to make positive profits (as $\alpha_{(1)} \geq 1$). Second, if $\Sigma < K < 1/4 + \Sigma$, we have an interior solution as the unconstrained share of distributed profits is strictly positive and less than unity; in that case, all individuals become investors ($n_c = 1$). Finally, if $K \leq \Sigma$, we have a corner solution with $\alpha_{(1)} = 0$. Here, the capital requirement is so small that the entrepreneur

¹³The entrepreneur receives K/n_c from each of the n_c crowdfunders, which exactly covers her capital requirement K .

does not need to distribute profits: community benefits are sufficient to motivate investors. In that case, the number of crowdfunders is such that $\alpha_{(1)} = 0$, i.e., $n_c = K/\Sigma$. This implies that crowdfunders do not expect any financial rewards from their investment. As mentioned in the Introduction, this situation corresponds to crowdfunders providing donations rather than participating in the profits of the firm. This is consistent with empirical facts that some platforms specialize in intermediating between firms and crowdfunders for donations. In this instance, the benefits in terms of utility are the community benefits accruing from making production possible. The difference with existing literature on donations (e.g., Glaeser and Shleifer, 2001) is that here donators are consumers rather than altruistic individuals.

Collecting the previous results, we can express the entrepreneur's residual profits in the first option as follows:

$$\Pi_{(1)} = \begin{cases} \frac{1}{4} & \text{if } 0 \leq K \leq \Sigma, \\ \frac{1}{4} - (K - \Sigma) & \text{if } \Sigma < K \leq \frac{1}{4} + \Sigma, \\ 0 & \text{if } K > \frac{1}{4} + \Sigma. \end{cases} \quad (9)$$

2. *Small base of crowdfunders.* In the second option, crowdfunders are such that $\theta \geq \theta_i$. We therefore have that $n_c = 1 - \theta_i$. Using expression (7) and solving for α , we find

$$\alpha_{(2)} = 2(2n_c^2 - n_c(1 + 2\Sigma) + 2K).$$

The entrepreneur sets n_c to maximize $\Pi = (1 - \alpha_{(2)})(1/4)$, subject to (i) $n_c \leq 1/2$ (as crowdfunders must belong to the set of consumers), (ii) $\alpha_{(2)} \geq 0$.¹⁴ As $\partial\alpha_{(2)}/\partial n_c = 8n_c - 2(1 + 2\Sigma)$, the unconstrained optimum is

¹⁴It is clear that the entrepreneur will optimally choose $\alpha < 1$ as she always has the possibility to refrain from launching her project and make zero profits.

found as

$$n_c^* = \frac{1}{4}(1 + 2\Sigma).$$

This value satisfies constraint (i) as long as $\Sigma \leq 1/2$. Computing the corresponding value of $\alpha_{(2)}$, we find

$$\alpha_{(2)}^* = \frac{1}{4} \left(16K - (1 + 2\Sigma)^2 \right).$$

Hence, constraint (ii) is satisfied as long as $K \geq (1 + 2\Sigma)^2 / 16$. For this low level of profit sharing $\alpha_{(2)}^*$, only consumers with highest θ will be willing to become investor. Crucially, under $\alpha_{(2)}^*$, we obtain a level of n_c^* such that all the consumers for which the incentive constraint holds need to invest in order to ensure sufficient financing for the firm. Any deviation would lead to stopping the project. Thus, they are all pivotal, which in turn explains why investors rationally set their outside option equal to zero (as assumed earlier).

Four cases are possible depending on the values of Σ and K . After having explored these cases, we can express the entrepreneur's residual profit in the second option as follows:¹⁵

$$\Pi_{(2)} = \begin{cases} \frac{1}{4} & \text{if } K \leq \min \left\{ \frac{(1+2\Sigma)^2}{16}, \frac{\Sigma}{2} \right\}, \\ \frac{1}{4} + \frac{(1+2\Sigma)^2}{16} - K & \text{if } K \in \left[\frac{(1+2\Sigma)^2}{16}, \frac{1}{4} + \frac{(1+2\Sigma)^2}{16} \right] \text{ and } \Sigma \leq \frac{1}{2}, \\ \frac{1}{4} + \frac{\Sigma}{2} - K & \text{if } K \in \left[\frac{\Sigma}{2}, \frac{1}{4} + \frac{\Sigma}{2} \right] \text{ and } \Sigma \geq \frac{1}{2}, \\ 0 & \text{otherwise.} \end{cases} \quad (10)$$

To determine the entrepreneur's best conduct in period 1, we need now to compare expressions (9) and (10) and to identify the best option for each

¹⁵The details can be found in a technical appendix available from the authors.

combination of parameters. The next lemma summarizes our results.¹⁶

Lemma 2 *The entrepreneur's (residual) profit under crowdfunding/profit-sharing is equal to*

$$\Pi_s = \begin{cases} \frac{1}{4} & \text{if } 0 \leq K \leq f(\Sigma), \\ \frac{1}{4} + f(\Sigma) - K & \text{if } f(\Sigma) \leq K \leq f(\Sigma) + \frac{1}{4}, \\ 0 & \text{if } K \geq f(\Sigma) + \frac{1}{4}. \end{cases} \quad (11)$$

with $f(\Sigma) = \Sigma$ for $\Sigma < \frac{3}{2} - \sqrt{2} \simeq 0.086$ and $f(\Sigma) = \frac{(1+2\Sigma)^2}{16}$ otherwise.

It is intuitive, and obvious from expression (11) that the entrepreneur's profit weakly decreases with K and weakly increases with Σ . It is also interesting to note that when crowdfunding with profit-sharing allows the entrepreneur to operate (i.e., for $K < f(\Sigma) + 1/4$), it yields a larger profit than the traditional scheme based on uniform pricing and other sources of funding. Recall indeed from the previous section that profit under the latter scheme is equal to $1/4 - K$. Naturally, this result would have to be qualified if we assumed that the entrepreneur had to incur some cost to provide community benefits to her crowdfunders (here, we have implicitly assumed that this cost is zero).

Comparison of crowdfunding mechanisms

We compare here the two crowdfunding mechanisms from the point of view of the entrepreneur. Our goal is to identify the configurations of parameters for which the entrepreneur prefers one or the other mechanism. To this end, we compare the equilibrium profits given in expressions (6) and (11). Obviously, the magnitude of the community benefits in the two mechanisms,

¹⁶The details can again be found in a technical appendix available from the authors.

σ and Σ , play an important role in the comparison: the larger σ relatively to Σ , the more likely it is that the entrepreneur will prefer pre-ordering to profit-sharing, and conversely. It would be wrong to think, however, that one mechanism strictly dominates the other one as soon as the difference between the community benefits goes beyond some threshold. Actually, the choice between the two mechanisms also depends on the amount of capital that the entrepreneur has to raise.

We show this graphically by plotting the profits in the two mechanisms as a function of the amount of capital K , as done in Figure 1. To cover all potential scenarios, we have deliberately chosen to represent the pre-ordering profit Π_p for a large value of σ , namely $\sigma > 1/2$. We have then drawn the profit-sharing profit Π_s for increasing values of Σ , namely $0 < \Sigma_1 < \Sigma_2 < \Sigma_3 < \Sigma_4$. Each of these values belongs to one of four possible configurations of parameters, whose exact outlines are depicted in Figure 2.

(Insert Figures 1 and 2 about here.)

Area A. For Σ close to zero (e.g., Σ_1 in Figure 1), pre-ordering dominates profit-sharing for any $K \geq 0$. This is so if profit-sharing becomes unprofitable for a smaller value of K than pre-ordering does; that is, if $1/4 + f(\Sigma) < (1 + 2\sigma)/8$, where we recall from expression (11) that $f(\Sigma) = \max\{\Sigma, (1 + 2\Sigma)^2/16\}$. Developing the latter inequality, we have $f(\Sigma) < (2\sigma - 1)/8$, which is only possible if $\sigma > 1/2$.

As Σ increases, we observe that profit-sharing starts dominating pre-ordering once K goes beyond some threshold. Let K_{ps} denote this threshold. We see on the graph that K_{ps} can take on three different values.

Area B. For small values of Σ (e.g., Σ_2 in Figure 1), Π_p “cuts” Π_s when the latter function jumps down from a positive value to zero, i.e., for $K = (1 + 2\sigma)/8$. Hence, $K_{ps} = (1 + 2\sigma)/8$ in this case, which occurs for (σ, Σ) such that $(2\sigma - 1)/8 < f(\Sigma) < (4\sigma - 1)/16$; we note that a necessary condition for this case to exist is $\sigma > 1/4$.

Area C. For intermediate values of Σ (e.g., Σ_3 in Figure 1), Π_p and Π_s intersect in their respective middle sections; hence K_{ps} is the value of K that solves $1/4 + f(\Sigma) - K = (1/16) \left(1 + \sqrt{1 - 8K/(1 + 2\sigma)}\right)^2$. This case occurs for (σ, Σ) such that $(4\sigma - 1)/16 < f(\Sigma) < \sigma^2/(1 + 4\sigma)$.

Area D. For large values of Σ (e.g., Σ_4 in Figure 1), Π_p and Π_s intersect in their respective top sections; it is then easily found that $K_{ps} = \sigma^2/(1 + 4\sigma)$; this occurs for $f(\Sigma) > \sigma^2/(1 + 4\sigma)$.

We collect these results in the following proposition.

Proposition 1 *If $\sigma > 1/2$ and $f(\Sigma) < (2\sigma - 1)/8$, then the entrepreneur prefers pre-ordering over profit-sharing for any value of K . Otherwise, there always exists a cut-off value K_{ps} such that the entrepreneur prefers pre-ordering for $K < K_{ps}$ and prefers profit-sharing for $K > K_{ps}$.*

The intuition behind this result goes as follows. When the capital requirement is small, it poses no constraint for the entrepreneur, whatever the crowdfunding mechanism that she chooses to implement. That is, with pre-ordering, she can set the optimal discriminating prices and with profit-sharing, she does not need to distribute any profit. The difference comes from the fact that under pre-ordering, a larger share of consumers buy the product than under profit-sharing, which generates higher revenues for the entrepreneur. The net profit is thus larger under pre-ordering than under

profit sharing. Yet, the gross profit may be lower: under pre-ordering, the entrepreneur must still deduct the fixed-cost K , while under profit-sharing, she must not as K is entirely covered by the investors' contributions. One understands thus that pre-ordering dominates only as long as K is not too large. As K grows, it becomes preferable to have the capital financed through investors' contributions rather than through pre-sales of the product.

The previous argument follows from the nature of the community benefits in the two mechanisms. Individuals are heterogeneous with respect to community benefits under pre-ordering, but homogeneous under profit-sharing. The practical implication of this difference is that the entrepreneur can more easily tax community benefits away with profit-sharing than with pre-ordering.

So far, we have allowed for any combinations of σ and Σ . We could, however, impose some relationship between the extent of community benefits under the two mechanisms. A natural benchmark would be to impose *ex ante identical total community benefits* in the two mechanisms; that is

$$\Sigma = \int_0^1 \theta \sigma d\theta \Leftrightarrow \Sigma = \frac{\sigma}{2}.$$

This relationship is represented by the dashed line in Figure 2. We see that this line is completely included in Area D. We can therefore conclude:

Corollary 3 *If total community benefits are ex ante identical in the two mechanisms, i.e., if $\Sigma = \sigma/2$, then the entrepreneur chooses pre-ordering for $K < \sigma^2/(1 + 4\sigma)$ and profit-sharing otherwise.*

Concluding remarks

This paper sheds light on managerial implications of crowdfunding practices used to set up entrepreneurial activities. It stresses the need for building a community that ultimately enjoys additional private benefits from their participation to make crowdfunding a viable alternative to investor- or creditor-based funding such as through banks, business angels or even venture capital. In setting up the initiative, the entrepreneur potentially faces the following trade-off. Crowdfunding allows for price discrimination. In the case of pre-ordering, the capacity to optimally implement price-discrimination between pre-ordering consumers (the crowdfunders) and other consumers may, however, be constrained by the amount of capital that the entrepreneur needs to raise to cover the up-front (fixed) costs. Whenever this amount exceeds some threshold, the distortion in the price discrimination becomes excessive, in which case the profitability of the crowdfunding initiative is reduced. For larger amounts, crowdfunding based on profit sharing of equity issuance becomes better when community benefits are associated with the decision to finance the entrepreneurial project. This is because larger amounts enable the entrepreneur to make more individuals participate in the financing without affecting too much the fraction of profits the entrepreneur needs to give up to obtain financing.

To our knowledge, this is the very first study offering a theoretical analysis of crowdfunding. It also highlights new follow-up research questions on the topic. For instance, an interesting avenue for future research is to incorporate the fact that the crowdfunders can at times also participate in strategic decisions regarding product development or even have voting rights on strategic decisions. In this case, control rights and voting power become an additional benefit for the participating crowd. Crowdfunding

through pre-ordering will have a very different effect on information and voting results than if the crowd shares profits with the entrepreneur. 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.

Another interesting avenue is to connect the topic to the ongoing research on platforms and two-sided markets. Several crowdfunding platforms have emerged recently, such as *IndieGoGo*, *Kickstarter*, *Sandawe*, *SellaBand*, *My-MajorCompany* and *Artistshare*, similar in spirit to online lending markets (Everett, 2008; Freedman and Jin, 2010; Hildebrand, Puri and Rocholl, 2011). These platforms intermediate between entrepreneurs and potential crowdfunders, creating a two-sided market.¹⁷ Our understanding of the role played by crowdfunding platforms is still limited; it is worth investigating the extent to which platforms increase the chances of success of crowdfunding initiatives or solve asymmetric information issues. As an example, for crowdfunders, platforms may facilitate learning of product quality through the possible interaction between crowdfunders (e.g., via other crowdfunders' comments on a forum) or by observing the contributions of other crowdfunders. More research could be done along the line of peer effects as it relates to crowdfunding platforms, as suggested by Ward and Ramachandran (2010), in particular in the area of strategic management and entrepreneurship.

Future work may further explore information motivations of entrepreneurs. Indeed, while the primary goal of crowdfunding is certainly to raise money, it may also help firms in testing, promoting and marketing their products, in gaining a better knowledge of their consumers' tastes, or in creating new

¹⁷See, most notably, Eisenmann, Parker and Van Alstyne, 2006, 2011, and Zhu and Iansiti, 2012 in the strategic management literature; see also Belleflamme and Peitz, 2010 (Chapter 22), for a textbook treatment of the industrial organization aspects.

products or services altogether. In this sense, 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. Crowdfunding seems thus to have implications that go beyond the financial sphere of an organization: it also affects the flow of information between the organization and its customers. 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.

Appendix

We develop here the option of attracting a small base of crowdfunders under profit-sharing. As explained in the text, the entrepreneur maximizes her residual profit under two constraints: (i) $n_c \leq 1/2$ and (ii) $\alpha_{(2)} \geq 0$. Constraint (i) is met if $\Sigma \leq 1/2$; constraint (ii) is met if $K \geq (1 + 2\Sigma)^2 / 16$. We must thus distinguish among four cases.

1. If $\Sigma < 1/2$ and $K > (1 + 2\Sigma)^2 / 16$, we have an interior solution: the number of crowdfunders is n_c^* and the share of distributed profit is $\alpha_{(2)}^*$; the corresponding residual profit for the entrepreneur is computed as $\Pi_{(2.1)} = \max \left\{ 1/4 + (1 + 2\Sigma)^2 / 16 - K; 0 \right\}$.

2. If $\Sigma \geq 1/2$ and $K > (1 + 2\Sigma)^2 / 16$, then the first constraint is violated and the entrepreneur chooses $n_c = 1/2$; the share of distributed profit is then given by $2(2K - \Sigma)$ and the entrepreneur's residual profit is $\Pi_{(2,2)} = \max \{1/4 + \Sigma/2 - K; 0\}$.
3. If $\Sigma < 1/2$ and $K \leq (1 + 2\Sigma)^2 / 16$, then the second constraint is violated and n_c is chosen so that $\alpha_{(2)} = 2(2n_c^2 - n_c(1 + 2\Sigma) + 2K) = 0$. Let \hat{n}_c denote the smallest root of this polynomial. It can be checked that $\Sigma < 1/2$ implies $\hat{n}_c < 1/2$. As under the first option, the low capital requirement allows the entrepreneur to collect K without having to distribute any profit. Hence, $\Pi_{(2,3)} = 1/4$.
4. If $\Sigma \geq 1/2$ and $K \leq (1 + 2\Sigma)^2 / 16$, then two sub-cases have to be distinguished. If $K < \Sigma/2$, then $\hat{n}_c < 1/2$. Hence the entrepreneur can set $\alpha_{(2)} = 0$ and earns $\Pi_{(2,3)} = 1/4$. Otherwise, for $\Sigma/2 \leq K \leq (1 + 2\Sigma)^2 / 16$, the entrepreneur sets $n_c = 1/2$ and earns $\Pi_{(2,2)} = \max \{1/4 + \Sigma/2 - K; 0\}$.

We obtain expression (2) by collecting the results of the previous four cases.

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Table 1: Definition of Variables

Variable	Definition
K	Fixed amount of money needed to start production
s	Baseline quality of the good (normalized to 1)
θ	Marginal utility from increasing the quality of the good; we assume this variable to be distributed uniformly between $[0,1]$ for consumers
n_c	Number of crowdfunders
Π, π_1, π_2	Total profits of the entrepreneur (Π), profits of the entrepreneur in the first period (π_1) and second period (π_2); by definition, $\Pi = \pi_1 + \pi_2$
<i>Variables specific to the model of pre-ordering:</i>	
σ	Community benefits for crowdfunders (i.e., pre-ordering consumers)
p_c, p_r	Price charged to the crowdfunders (p_c) and regular consumers (p_r); one benchmark is the price charged to consumers under traditional funding, which we denote by p_u
<i>Variables specific to the model of profit-sharing:</i>	
Σ	Community benefits for crowdfunders (i.e., participating investors)
α	Share of profits that the entrepreneur will distribute to crowdfunders (with $0 \leq \alpha < 1$)
p	Price charged to consumers in the second period (here, the same price is charged to all consumers)

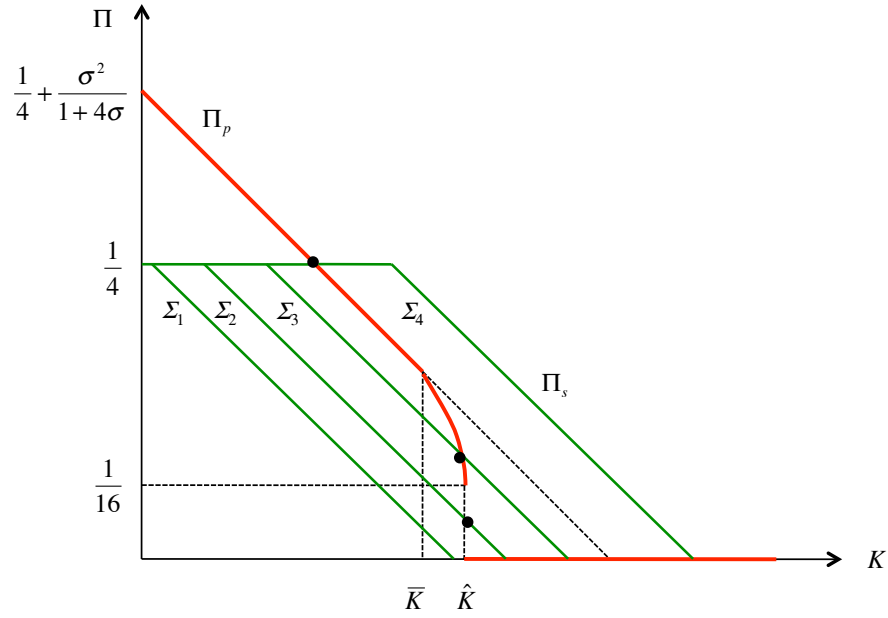


Figure 1: Profits in the two crowdfunding mechanisms

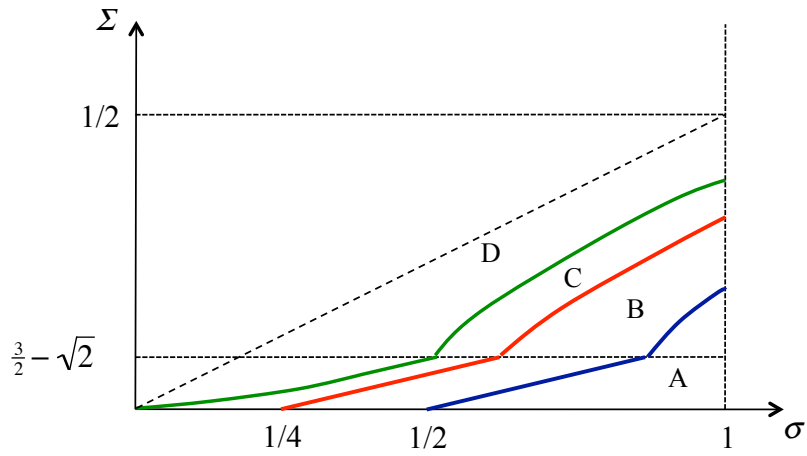


Figure 2: Choice of crowdfunding mechanism