Crowdfunding: An Industrial Organization Perspective[*]

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Abstract

The first objective of the paper is to identifiy a number of issues related to crowdfunding that are worth studying from an industrial organization (IO) perspective. To this end, we first propose a definition of crowdfunding; next, on the basis on a previous empirical study, we isolate what we believe are the main features of crowdfunding; finally, we point to a number of strands of the literature that could be used to study the various features of crowdfunding. The second objective of the paper is to propose some preliminary efforts towards the modelization of crowdfunding. In a first model, we associate crowdfunding with pre-ordering and price discrimination, and we study the conditions under which crowdfunding is preferred to traditional forms of external funding. In a second model, we see crowdfunding as a way to make a product better known by the consumers and we give some theoretical underpinning for the empirical finding that non-profit organizations tend to be more successful in using crowdfunding.

JEL classification codes: G32, L11, L13, L15, L21, L31

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1 Introduction

In the music industry, a new type of Internet-based record labels have recently been created. Labels, such as *SellaBand*, *MyMajorCompany* or *Artist-share*, 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 on (with a minimum pledge); when artists reach a threshold pledge (e.g., $50.000 on *SellaBand*), the company uses the money to produce and distribute their 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 this model has been primarily used in the entertainment industry 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. As a "crowd" of investors is tapped, the term "crowdfunding" has been coined to describe this new source of finance

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). The crowd-funders (those who provide the money) can at times also participate in strategic decisions or even have voting right.

Obviously, the main objective of crowdfunding is to provide entrepreneurs

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

with an alternative way to raise funds. It is indeed 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 the 3Fs (friends, family and fools). 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. Crowdfunding may then appear as a useful alternative route.

However, 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 area of corporate finance but also in the area of industrial organization.

Our goal in this paper is twofold. First, we want to identify a number of issues related to crowdfunding that are worth studying from an industrial organization perspective. To this end, we proceed in three steps (Section 2): we start by defining more precisely what we hear by crowdfunding; next, on the basis on a previous empirical study, we isolate what we believe are the main features of crowdfunding; finally, we point to a number of strands of the literature (in industrial organization or, more generally, in microeconomics) that we could use to study the various features of crowdfunding. We move then to our second objective, which is to propose some preliminary efforts towards the modelization of crowdfunding. We develop two models that address different features of crowdfunding. In Section 3, we associate crowdfunding with pre-ordering and price discrimination, and we study the conditions under which crowdfunding is preferred to traditional forms of external funding. In Section 4, we see crowdfunding as a way to make a product better known by the consumers and we give some theoretical underpinning for the empirical finding that non-profit organizations tend to be more successful in using crowdfunding. Our main results are summarized in Propositions 1 and 2. We offer some concluding remarks and directions for future research in Section 5.

2 A road map for studying crowdfunding

Our objective in this section is to answer the following three 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? (iii) Which strands of the literature could we use to study the issues raised by the practice of crowdfunding?

2.1 A definition of crowdfunding

The concept of crowdfunding[2] 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) propose the following definition:

Definition 1 *"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

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[2]We follow here closely Section 2 of Lambert and Schwienbacher (2010).

[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).

crowdsourcing, since the latter encompasses also financial help.

Several platforms have emerged recently, such as *Fundable*, *Kickstarter*, *Kiva*, *Sandawe*, and *SellaBand*. These intermediate between entrepreneurs and potential crowd-funders. 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. Through a case study, Larralde and Schwienbacher (2010) highlight the importance of efficient communication and networking. They argue that this is an inherent component of any crowdfunding process. The argument is also in line with the study of Lee et al. (2008), who identify three properties of Web 2.0 that enhances the ability of entrepreneurs: openness, collaboration, and participation. In contrast to the Internet that existed before the bursting of the dot-com bubble, the more recent Web 2.0 technology allows user to provide content (beyond simply reading existing one), interact with each other and thereby create value for the company (Lee et al., 2008).

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. Companies cannot do a general solicitation, unless they received prior authorization from their national securities regulator. In many countries, there is also a limit as to how many private investors a company can have. 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,

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

shareholder contracts for the purchase of shares were however only signed with 100 individuals, as a way to overcome these legal problems. This creates important legal limitations to crowdfunding initiatives, given that the input of the crowd is capital and not an idea or time. 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. Therefore, most initiatives do not offer shares but provide other types of rewards such as a product or membership.

Crowd-funders 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. In practice, entrepreneurs relying on crowdfunding may combine it with other forms of crowdsourcing. This is the case for instance of *MediaNoMad* that also obtained from the crowd time and expertise (Larralde and Schwienbacher, 2010).

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 of open-source case, 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 2 *Crowdfunding involves an open call, essentially 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 Key features of crowdfunding

We summarize here the main findings of the recent empirical study of Lambert and Schwienbacher (2010). This study is helpful in providing a better understanding of how crowdfunding initiatives are structured and what motivates them.

Data. The authors hand-collected data from various sources on all possible crowdfunding initiatives that they could identify on the Internet. Data collection took place end of 2009 and early 2010. Since there is no database available or even listing, the authors relied on the Internet to construct their sample.[6] The focus was on crowdfunded ventures and projects, which largely excludes all initiatives made by artists. In total, they identified 88 cases and were able to collect sufficient (but still partially incomplete) information on 51 of them. A questionnaire was then used to obtain further information. Out of the 69 entrepreneurs that could be contacted, 21 returned complete (or partial) answers (a response rate of about 30%).

Summary statistics. Here are the main facts that can be extracted from the collected information.

- *Demographics*: 35.3% of the initiatives are from the United States and 49% from Europe.

- *Type of organizational form*: out of the 50 crowdfunding initiatives for which the information was available, 23 are connected with a specific project only, 18 stem from for-profit companies, 8 stem from non-profit associations, and 1 is the work of an individual.

- Crowdfunding is a *recent phenomenon*: over 80% of the respondents have used crowdfunding for projects or for their own company only very recently (i.e., since 2007).

- *Motivation*: raising money was a strong motivation for all respondents, getting public attention was relevant (or highly relevant) for over 85%, and obtaining feedback on the product/service offered was relevant (or highly relevant) for about 60% of the respondents.

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[6]One advantage is that firms and individuals using crowdfunding as a way to collect funds typically use the Internet to do so, as well as social networks (such as blogs, Facebook and Twitter). This clearly facilitated the construction of the sample.

- *Source of funding*: many of the respondents combine crowdfunding with other sources of finance, notably with own money, friends & family money, business angel and government subsidy.

- *Type of investment*: three forms of investment are observed in the sample, namely donation, active investment, and passive investment; pure donation constitutes 22% of crowdfunding; the rest represents investments (i.e., the crowd-funder expects to receive a return or reward), ventilated between active investment (32%) and passive investment (60%).

- *Return/reward to investors*: 76.5% of the respondents offer a reward to their crowd-funders, mostly in form of a right to receive the product (2/3 of the cases) or shares that may yield dividends in the future (1/3 of the cases); direct cash payment is expected in 22.2% of the cases where a reward/return is promised; in two thirds of the cases, also other forms of reward are proposed (e.g., getting credit on an album or a film, giving money to a charity of the person's choice, etc.).

- *Means of communication*: almost all respondents used very extensively the Internet as a mode of communication with the "crowd", evidencing the reliance on Web 2.0 for modern crowdfunding; the most widely used methods of Internet is an own website, community blogs, Facebook, personal emails and Twitter; other methods are used by less than 50% of the respondents; however, only 20% of the respondents (according to the survey) used a crowdfunding platform such as *Couch Tycoon*.

Interesting correlations between variables

- Crowdfunding initiatives taking place as a company tend to involve more often active investments and fewer passive investments.

- Companies are more likely to enable individuals to provide input or vote on the project; conversely, non-profit organizations offer active involvements of investors less often.

- A negative correlation exists between whether a reward is offered and whether it is a passive investment, which suggests that rewards and

control are used as substitutable incentives (investors may require more rewards if they cannot be involved in the happening of the initiative).

- Through a multivariate analysis, the authors examine what drives the chances of success of crowdfunding initiatives. A striking result is that non-profit associations are significantly more likely to achieve their target level of capital in comparison with other organizational forms (corporation, individual or in connection with a single project). This result appears robust to different econometric specifications.

2.2.1 Key features from an industrial organization perspective

We propose here our own reading of the previous data, with the aim to identify a number of issues that seem interesting to study from an industrial organization (IO) perspective.

1. *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 organization: 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.

2. *Crowdfunding is a peculiar form of funding, with customers 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 industrial organization 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.

3. *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 this 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 Sections 3 and 4, we present preliminary modeling efforts in the directions that we have just outlined. In particular, the model of Section 3 is an attempt to address our first point, namely that crowdfunding mixes funding and information motivations; in this model, the firm uses crowdfunding to induce consumers to reveal their private information, i.e., their willingness to pay for the product. In the model of Section 4, we address the third point by letting an entrepreneur choose not only her funding method (crowdfunding or external funding) but also her organizational form (for-profit or non-profit).

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

2.3 Related literature

As crowdfunding is a recent phenomenon, it is not a surprise that there is virtually no literature at all on the topic. The little that exists concerns the broader concept of crowdsourcing and can hardly be applied to the specific case of crowdfunding. One of the very few academic articles on crowdfunding is from Kappel (2009) that distinguishes *ex post facto* crowdfunding (e.g., when a product is offered after financing is provided) from *ex ante* crowdfunding (e.g., financial support for lobbying or political activities). Wojciechowski (2009) discusses donations in connection with projects funded through crowdfunding. The author argues that social networks can become a worthwhile model of money collection for many charity organizations and NGOs. However, these two papers are of limited use for our purpose as they both lie outside the field of industrial organization.

We have thus to look more broadly at the literature (in IO and elsewhere) to find insights that could be used to model the specific features of crowdfunding. We propose here a number of avenues. (TO BE COMPLETED)

2.3.1 For-profit vs. non-profit

To analyze the choice of organizational form, the so-called 'contract failure literature' may provide useful insights. 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. Relatedly, Ghatak and Mueller (2009) develop a theoretical framework of labor donation theory to investigate under which conditions non-for-profit organizations can provide a better alternative to motivated workers than other forms of organizations.

2.3.2 Choice of funding method

When crowdfunding is concerned purely from a financial perspective, it may be useful to look at this 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. Theoretical considerations about the optimal timing between using internal and external resources is provided by Schwienbacher (2007).

2.3.3 Customers as investors

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. Useful insights can certainly be found in the extensive literature in microeconomics that studies the private provision of public goods (quote references). 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).

A related strand of literature argues that individuals may provide public goods due to social reputation, which induces pro-social behavior (Bénabou and Tirole, 2006). Moreover, experimental economics studies indicate that individuals become discouraged when faced with fines in case of underperformance or when treated unfair (Falk and Kosfeld, 2006), indicating that monetary incentives may at times deter individuals to undertake initiatives and behave altruistically.

3 Crowdfunding, pre-sale and menu pricing

In this section, we focus on crowdfunding experiences where consumers are invited to pre-order the product. For the firm to be able to launch production, the amount collected through pre-ordering must cover the fixed cost of production. The firm prefers therefore that the consumers who pre-order are those with a high willingness to pay for the product. However, a firm is

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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: with respect to external funding, crowdfunding has the disadvantage of delaying profits by one period and 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.

Intuitively, we expect crowdfunding to become more attractive as the discount factor increases (meaning that delaying profits becomes less costly) and as the initial capital requirement decreases (so that pre-sales can cover them). Our main result (see Proposition 1) gives a precise structure to this intuition.

3.1 The 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 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 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 $r + \theta s - p$. [7]. 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.[8] For

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

[8]Naturally, we plan in future work to endogenize the choice of quality. In the spirit of Glaeser and Schleifer (2001), we plan to contrast the quality choice of a for-profit and a non-profit firm (as we do in Section 4).

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—external funding or crowdfunding—with the following implications.

- If the firm chooses external funding, then, in period 1, it sets a price p for its product and incurs the fixed cost K; consumers decides to buy or not and the game stops.

- On the other hand, if the firm chooses crowdfunding, then the game has two more periods. 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 contributed to the financing of the firm, and p_n, the price to be paid by those consumers who have not. 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 $s + \sigma$; this enhanced quality may come from different experiences resulting from crowdfunding (early experience with the product, customization of the product, sense of belonging to a group of 'special consumers').

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 External funding

The case of external funding is straightforward. In period 1, the firm 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 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 external funding is thus equal to

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

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 probability that the product will indeed be put on the market in period 2. Consumers know that the product will be produced only if pre-sales cover the fixed cost. They therefore anticipate that the larger the number of consumers who pre-order the product, the more likely it is that the product will be produced.

3.3.1 Consumer choices

To model this, 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.[9] We adopt the fulfilled-expectations approach: consumers base their decision on their expectation 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 (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). As the initial expectation is realized, we have a fulfilled expectations equilibrium. Naturally, crowdfunding is doomed to failure under such equilibrium. As crowdfunding

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[9]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 asumption in future work.

experience of this sort 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 then needed, we have $p_1 = K/n^e$. So, if consumer expect of positive mass of contributors, they can be sure that the good will be produced. 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 (knowing that the product will be put on the market anyway). If she contributes, she pays p_1 today and gets tomorrow a product of enhanced quality $(s + \sigma)$ that she will pay at price p_c. Letting δ denote the discount factor, we first make the following assumption:

Assumption 2. $\delta\sigma < s$.

According to Assumption 2, the discounted value of the increase in perceived quality is lower than the original quality of the product.[10] We can express the expected utility when the consumer pre-orders 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_n. Hence, her expected utility is

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

So, for a consumer to contribute, we must have

$$U_c^e \quad \geq \quad U_n^e \Leftrightarrow \delta \left(\theta\sigma + p_n - p_c \right) \geq \frac{K}{n^e}$$

$$\Leftrightarrow \quad \theta \geq \frac{K}{\delta\sigma n^e} - \frac{p_n - p_c}{\sigma} \equiv \bar{\theta} \left(n^e \right).$$

All consumers with a value of θ larger than $\bar{\theta}(n^e)$ prefer to pre-order. We observe thus that the mass of contributors 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)

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[10]Under this assumption (which seems rather realistic), external funding makes production profitable for a larger range of values of K than crowdfunding.

the difference between the price for non-contributors and for contributors $(p_n - p_c)$ increases. For the sake of the exposition, let us write $\Delta \equiv p_n - p_c$. For a given expected mass of contributors n^e, the actual mass of contributors is thus equal to $n = 1 - \bar{\theta}(n^e)$. We require fulfilled expectations at equilibrium: $n = n^e$. We must thus solve

$$n = 1 - \frac{K}{\delta \sigma n} + \frac{\Delta}{\sigma} \Leftrightarrow \sigma \delta n^2 - \delta(\sigma + \Delta)n + K = 0.$$

The latter polynomial has two real roots as long as $z \equiv \delta^2(\sigma + \Delta)^2 - 4\sigma \delta K > 0$, which is equivalent to

$$\Delta > 2\sqrt{\frac{\sigma K}{\delta}} - \sigma. \tag{2}$$

Note that the RHS of the previous inequality is positive if $K \geq \delta \sigma / 4$ and negative otherwise. Suppose for now that the latter condition is satisfied. We will have to check below whether it is indeed the case. Then, the two roots are

$$n = \frac{1}{2\sigma \delta}\left(\delta(\sigma + \Delta) \pm \sqrt{\delta^2(\sigma + \Delta)^2 - 4\sigma \delta K}\right).$$

Intuitively, the actual mass of contributors should increases with $(\sigma + \Delta)$, which drives us to select the large root, i.e.

$$n = \frac{1}{2\sigma \delta}\left(\delta(\sigma + \Delta) + \sqrt{\delta^2(\sigma + \Delta)^2 - 4\sigma \delta K}\right).$$

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 $r + \theta s - p_n \geq 0$, or $\theta \geq (p_n - r)/s \equiv \hat{\theta}$. As long as $0 < (p_n - r)/s < 1 - n$, the firm's profit can be written as

$$
\begin{aligned}
\pi &= p_1 n - K + \delta p_c n + \delta p_n \left(1 - n - \frac{p_n - r}{s}\right) \\
&= \delta p_n \left(1 - \frac{p_n - r}{s}\right) - \delta(p_n - p_c)n.
\end{aligned}
$$

Recalling that Δ stands for the price difference $p_n - p_c$, we can express the firm's profit as

$$\pi = \delta p_n \left(1 - \frac{p_n - r}{s}\right) - \delta \Delta \frac{1}{2\sigma \delta}\left(\delta(\sigma + \Delta) + \sqrt{\delta^2(\sigma + \Delta)^2 - 4\sigma \delta K}\right).$$

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

The derivative of profit with respect to Δ is

$$\frac{d\pi}{d\Delta} = -\frac{1}{2\sigma}\left[\delta(\sigma+\Delta) + \sqrt{\delta^2(\sigma+\Delta)^2 - 4\sigma\delta K}\right.$$
$$\left. +\Delta\left(\delta + \frac{\delta^2(\sigma+\Delta)}{\sqrt{\delta^2(\sigma+\Delta)^2 - 4\sigma\delta K}}\right)\right] \qquad (3)$$

Recalling condition (2), we have to distinguish between two cases.

Case 1. $K \geq \delta\sigma/4$. In this case, $\Delta \geq 0$ under condition (2). Then, expression (3) is clearly negative, meaning that the optimal choice is the lowest admissible value of Δ:

$$\Delta = 2\sqrt{\frac{\sigma K}{\delta}} - \sigma.$$

As $p_n = (r+s)/2$ and $p_c = p_n - \Delta$, we have

$$p_c = \frac{r+s}{2} - 2\sqrt{\frac{\sigma K}{\delta}} + \sigma \text{ and } \pi = \delta\frac{(r+s)^2}{4s} + \delta\sqrt{\frac{\sigma K}{\delta}} - 2K.$$

Note that we still need to ensure that $(p_n - r)/s < 1-n$, which is equivalent to

$$\frac{s-r}{2s} < 1 - \frac{1}{\sigma}\sqrt{\frac{\sigma K}{\delta}} \Leftrightarrow K < \frac{\delta\sigma(r+s)^2}{4s^2}.$$

If the latter condition is satisfied, it can be checked that a sufficient condition for the equilibrium profit to be positive is $\sigma < 2s$. Otherwise, for larger values of K, self-selection cannot be achieved and crowdfunding fails.

Case 2. $K < \delta\sigma/4$. Here, negative values of Δ are compatible with condition (2). To solve for $d\pi/d\Delta = 0$, we pose $Z = \delta^2(\sigma+\Delta)^2 - 4\sigma\delta K$ and we rewrite the first-order condition as:

$$\delta(\sigma+\Delta) + \sqrt{Z} + \Delta\left(\delta + \frac{\delta^2(\sigma+\Delta)}{\sqrt{Z}}\right) = 0.$$

Developing, we find that the latter expression is equivalent to

$$\sqrt{Z} = \frac{4\sigma\delta K - \delta^2(\sigma+\Delta)(\sigma+2\Delta)}{\delta(\sigma+2\Delta)}. \qquad (4)$$

17

As long as the RHS is positive, we can take the square of the two sides of the equality, replace Z by its value and solve for Δ to get:

$$\Delta^* = \frac{4K - \delta\sigma}{2\delta}.$$

Note that $K < \delta\sigma/4$ implies that $\Delta^* < 0$, i.e. that $p_c^* > p_n^*$: contributors pay more than non-contributors in period 2.

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

$$\frac{4K - \delta\sigma}{2\delta} > 2\sqrt{\frac{\sigma K}{\delta}} - \sigma \Leftrightarrow \left(\frac{4K - \delta\sigma}{2\delta} + \sigma\right)^2 > 4\frac{\sigma K}{\delta} \Leftrightarrow \frac{(4K - \sigma\delta)^2}{4\delta^2} > 0,$$

which is indeed true. We also need to check that the RHS of expression (4), as we assumed it. We compute

$$\frac{4\sigma\delta K - \delta^2 (\sigma + \Delta^*)(\sigma + 2\Delta^*)}{\delta(\sigma + 2\Delta^*)} = -\frac{1}{2}(4K - \sigma\delta) = -\delta\Delta^*$$

which is positive as we have shown above that $\Delta^* < 0$.

To proceed, note that

$$\delta^2(\sigma + \Delta^*)^2 - 4\sigma\delta K = \frac{(4K - \delta\sigma)^2}{4}.$$

As $K < \delta\sigma/4$,

$$\sqrt{\delta^2(\sigma + \Delta^*)^2 - 4\sigma\delta K} = -\frac{1}{2}(4K - \sigma\delta) = -\delta\Delta^*.$$

It follows that

$$n^* = \frac{1}{2\sigma\delta}(\delta(\sigma + \Delta^*) - \delta\Delta^*) = \frac{1}{2}$$

Recall that we need

$$\frac{p_n^* - r}{s} < 1 - n \Leftrightarrow \frac{s - r}{s} < \frac{1}{2} \Leftrightarrow s < 2r,$$

which is guaranteed by Assumption 1.

We can now compute optimal profit:

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

What do consumers pay in this case? It is easily checked that contributors pay $p_1 + \delta p_c = \frac{\delta}{2}(r + s + \sigma)$. 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 $-p + \delta (r + \theta_0 (s + \sigma)) = 0$, which is equivalent to $\theta_0 = \frac{1}{s+\sigma} \left(\frac{1}{\delta} p - r \right)$. The firm maximizes $\pi = \delta (p (1 - \theta_0))$. It is easy to check that the optimal price is $p = \frac{1}{2} \delta (r + s + \sigma)$. 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).

Summary. Profit in the crowdfunding case is given by

$$\pi_{\text{crowd}} = \begin{cases} \delta \frac{(r+s)^2}{4s} + \frac{\delta}{4} - K & \text{for } K < \frac{\delta\sigma}{4}, \\ \delta \frac{(r+s)^2}{4s} + \delta \sqrt{\frac{\sigma K}{\delta}} - 2K & \text{for } \frac{\delta\sigma}{4} \leq K < \frac{\delta\sigma(r+s)^2}{4s^2}, \\ 0 & \text{for } K \geq \frac{\delta\sigma(r+s)^2}{4s^2}. \end{cases} \tag{5}$$

3.4 Choice of funding method

The trade-off for the firm between the two methods is the following: with respect to external funding, crowdfunding has the disadvantage of delaying profits by one period and 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. Comparing expressions (1) and (5), we can distinguish between four cases.

1. For *very large values of the fixed cost*, i.e., for $K \geq (r + s)^2 / (4s)$, neither external funding nor crowdfunding allows the firm to enter the market in a profitable way.

2. For *large values of the fixed cost*, i.e., for $\delta\sigma (r + s)^2 / (4s^2) \leq K < (r + s)^2 / (4s)$, only external funding allows the firm to enter profitably.

3. For *intermediate values of the fixed cost*, , i.e., for $\delta\sigma/4 \leq K < \delta\sigma (r + s)^2 / (4s^2)$, crowdfunding is preferred to external funding as long as

$$\pi_{\text{crowd}} - \pi_{\text{ext}} = \delta \sqrt{\frac{\sigma K}{\delta}} - K - (1 - \delta) \frac{(r + s)^2}{4s} > 0.$$

We observe that the latter expression increases with δ and decreases with K for $K \geq \delta\sigma/4$. We expect thus crowdfunding to be preferred

for large enough δ and for low enough K. More precisely, the condition is equivalent to

$$-16s^2K^2 + 8s\left(2\sigma\delta s - (1-\delta)(r+s)^2\right)K - (1-\delta)^2(r+s)^4 > 0.$$

If $\delta < (r+s)^2/\left(\sigma s + (r+s)^2\right)$, then the latter polynomial admits no real root and is always negative, meaning that external funding is preferred. Otherwise, the polynomial admits two positive roots; to be positive, K must be lie between the two roots. It can be shown that the threshold $\delta\sigma/4$ lies between the two roots $\delta\sigma/4$. Hence, the condition for crowdfunding to be preferred can be written as

$$K < \frac{2\sigma\delta s - (1-\delta)(r+s)^2 + 2\sqrt{s\sigma\delta\left(s\sigma\delta - (1-\delta)(r+s)^2\right)}}{4s} \equiv \hat{K},$$

with $\hat{K}$ being larger than $\delta\sigma(r+s)^2/\left(4s^2\right)$ for δ large enough.[11]

4. For *small values of the fixed cost,* , i.e., for $K < \delta\sigma/4$, crowdfunding is preferred to external funding as long as

$$\pi_{\text{crowd}} - \pi_{\text{ext}} = \frac{\delta}{4} - (1-\delta)\frac{(r+s)^2}{4s} > 0 \Leftrightarrow \delta > \frac{(r+s)^2}{s+(r+s)^2} \equiv \bar{\delta},$$

i.e. for a sufficiently large discount factor.

We collecting these results in the following proposition.

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 external funding if the discount factor (δ) is large enough and the fixed cost of production (K) is not too large. In particular, crowdfunding is chosen for the following configurations of parameters:*

$$(1)\ K \quad < \quad \tfrac{\delta\sigma}{4}\ \text{and}\ \delta > \frac{(r+s)^2}{s+(r+s)^2},$$

$$(2)\ \tfrac{\delta\sigma}{4} \quad \leq \quad K < \min\left\{\hat{K}, \tfrac{\delta\sigma(r+s)^2}{4s^2}\right\}\ \text{and}\ \delta > \frac{(r+s)^2}{\sigma s+(r+s)^2}.$$

[11]For instance, if $\delta = 1$, then $\hat{K} = \sigma$, which is larger than $\sigma(r+s)^2/\left(4s^2\right)$.

4 Crowdfunding, product information and non-profit status

In the previous section, we considered crowdfunding as a mechanism through which a firm is able to gather information about the willingness to pay of its consumers. In this section, we continue to associate crowdfunding with a flow of information but we reverse the direction of the flow: here, the firm uses crowdfunding to increase consumer awareness and to disseminate information about the product it plan to market. In other words, the firm is no longer getting information *from* but giving information *to* the consumers. Moreover, we try to provide some theoretical underpinning for the empirical finding that crowdfunding initiatives that are structured as non-profit organizations tend to be significantly more successful than other organizational forms, even after controlling for various project characteristics (Lambert and Schwienbacher, 2010).

We study a model of horizontal differentiation between a firm with market power and a competitive fringe. Before setting the quality and the price of its product, the firm has first to choose its status (for-profit or non-profit) and its funding method (external funding or crowdfunding). The main implications of these two choices are as follows: (i) compared to the for-profit status, the non-profit status is a commitment device to produce higher quality; (ii) compared to external funding, crowdfunding reveals to the consumer their preference about the horizontal characteristic of the product. Combining these two features, we establish (see Proposition 2) that non-profit organizations are more likely to prefer crowdfunding over external funding than for-profit organizations.

4.1 The model

Suppose that two types of products (indexed by 1 and 2) are located at the extreme locations of the $[0, 1]$ interval. Letting l_i denote the 'location' of product i, we thus assume that $l_i \in \{0, 1\}$, $i = 1, 2$. Consumer locations x are uniformly distributed on the unit interval. Consumers incur a disutility from travelling to the location of the product that is linear in distance. They have mass 1. A consumer's indirect utility is written as $r_i - \tau|l_i - x| - p_i$ if the consumer buys one unit of product i, where τ measures how easily one unit of a product of type 1 can be substituted by one unit of a product of

type 2. Additional units of a product do not increase a consumer's utility. Furthermore, a consumer is interested in exactly one of the products. The willingness to pay r_i differs across product.

The product of type 2, located at 1, is in competitive supply (i.e., it is sold at marginal costs). We can think of a large group of small firms (a continuum, to be precise) that offer one unit each. These firms are heterogeneous in their costs and, in the aggregate, give rise to the cost function C. We assume here that firms have constant marginal costs c. Since product 2 is in competitive supply, $p_2 = c$. As for the willingness to pay of the consumers for product 2, we assume $r_2 > c$ (otherwise, product 2 would not be marketed); without loss of generality, we set $r_2 = 1$.

The product of type 1, located at 0, is sold by a single firm, noted 1. Hence, firm 1 enjoys some degree of market power which is, however, limited by the presence of the firms at the other location. Firm 1 has the possibility to choose the quality, r_1, of its product. For a quantity q and a quality r_1, firm 1's cost function is given $C(q, r_1) = cq + (\gamma/2) r_1^2$. The marginal cost, c, is thus assumed to be common to all firms. Without loss of generality, we set $c = 0$.

There are two periods. In period 1, the entrepreneur managing firm 1 chooses the status and the funding mechanism of the firm. In terms of status, the firm can be for-profit or non-profit. As for the funding mechanism, the choice is between crowdfunding and external funding (which encompasses usual sources of finance, such as own money, friends and family money, business angels or government subsidy). We clarify the implications of these choices below. In period 2, the entrepreneur sets the price and the quality of product 1.

For-profit vs. non-profit. The status of the firm does not affect its technological opportunities. The only impact is that under the non-profit status, the entrepreneur is restricted in her ability to distribute profits to herself. In particular, we make the following set of assumptions. As in Glaeser and Shleifer (2001), we assume that regardless of the status of the firm, the entrepreneur's utility is an increasing function of the difference between the quality of her product and the quality of the fringe product. That is, the entrepreneur gets a higher (lower) utility if the quality r_1 of her a product exceeds (falls short) of the quality of the fringe product ($r_2 = 1$).

This can be justified either by referring to some altruistic preference of the entrepreneur (her desire to provide better quality than the competition), or as a reduced form of some reputation mechanism that would be at work in a richer model with asymmetric information and repeat purchases.[12]

If the firm is for-profit, the entrepreneur earns the firm's profits as income; she then maximizes the following quasi-linear utility function:

$$U_F = pq - C(q, r_1) + b(r_1 - r_2),\tag{6}$$

where $b > 0$ is the marginal utility of increasing the quality of the product.

In contrast, if the firm is non-profit, the entrepreneur is forced, because of the non-distribution constraint, to consume profits as perquisites. We assume that the entrepreneur strictly prefers cash to perquisites; her utility from perquisites is thus modelled as a fraction $0 < d < 1$ of the profits, which leads to the following utility function

$$U_N = d(pq - C(q, r_1)) + b(r_1 - r_2).\tag{7}$$

Crowdfunding vs. external funding. Contrary to the previous section, we assume here that the two funding methods are as costly for the firm (there is a common fixed cost of capital K, which we set equal to zero without any loss of generality). We make this simplifying assumption so as to focus on one key aspect of crowdfunding, namely that it increases the awareness of the product for the consumers with respect to external funding. In particular, we assume that unless the firm chooses crowdfunding, consumers ignore their exact location x (i.e., they ignore the disutility that they face when purchasing one unit of either product). Crowdfunding, through its informative advertising effect, reveals their preference to the consumers. That is, crowdfunding provides information as to horizontal attributes of the products (but not as to vertical attributes as we assume that they are observable).

We now solve the two-stage decision problem, starting with the price-quality choices.

4.2 Price-quality combinations

We consider in turn external funding and crowdfunding. For each funding method, we contrast the entrepreneur's choices for a for-profit and for a

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[12]See Belleflamme and Peitz (2010, Chapter 12) for a review of such models.

non-profit firm.

4.2.1 Decisions under external funding

In this case, consumers ignore their exact location. Hence, their expected disutility when buying either product is $E\left(\tau|l_i - x|\right) = \tau/2$ for $l_i \in \{0, 1\}$. That is, consumers have, in expectation, the same disutility for the two products. Hence, they all choose to buy the product of firm 1 as long as

$$r_1 - \tfrac{1}{2}\tau - p \geq 1 - \tfrac{1}{2}\tau \Leftrightarrow p \leq r_1 - 1.$$

Clearly, whatever the status of the firm, it is in the entrepreneur's best interest to set $p = r_1 - 1 \equiv p_T$ (as long as $r_1 \geq 1$). At this price, all consumers buy (i.e., $q = 1$) as long as their expected net utility is non-negative: $r_1 - \tfrac{1}{2}\tau - (r_1 - 1) \geq 0$ or

$$\tau \leq 2, \tag{8}$$

which we assume to be satisfied.

If the firm is **non-profit**, the entrepreneur chooses r_1 to maximize $d\left[(r_1 - 1) - (\gamma/2)\,r_1^2\right] + b\,(r_1 - 1)$. The first-order condition yields $d - d\gamma r_1 + b = 0$. The optimal quality level is thus

$$r_1 = \frac{b + d}{d\gamma} \equiv r_{NE},$$

which is assumed to be larger than $r_2 = 1$ (we make the condition explicit below). We can then compute the entrepreneur's utility as

$$\begin{aligned}
U_{NE} &= d\left(\frac{b + d}{d\gamma} - 1\right) - d\frac{\gamma}{2}\left(\frac{b + d}{d\gamma}\right)^2 + b\left(\frac{b + d}{d\gamma} - 1\right) \\
&= \frac{(b + d)\,(b + d - 2d\gamma)}{2d\gamma}.
\end{aligned} \tag{9}$$

If the firm is **non-profit**, we easily find the optimal quality and utility by setting $d = 1$ in the above expressions (as the entrepreneur realizes the profit as income). That is

$$r_{FE} \equiv \frac{b + 1}{\gamma} \text{ and}$$

$$U_{FE} = \frac{(b + 1)\,(b + 1 - 2\gamma)}{2\gamma}. \tag{10}$$

We observe that $d < 1$ implies that $r_{NT} > r_{FT}$: *the entrepreneur delivers a higher quality when the firm is non-profit rather than for-profit.* This is the result of Proposition 1 in Glaeser and Shleifer (2001). The intuition is pretty clear: as a non-profit entrepreneur puts a relatively larger weight on quality increases in her utility (as $b/d > b$), she is induced to produce a higher quality. That is, the non-profit status can be seen as a commitment to improved quality because the entrepreneur is limited in her ability to pocket the profits. To guarantee positive utilities and prices in the two cases, we assume

$$b + 1 > 2\gamma. \tag{11}$$

Note that assumptions (8) and (11) define an open interval as long as $(b+1)/(2\gamma) > \tau/2$, which is equivalent to $\tau\gamma < b + 1$.

4.2.2 Decisions under crowdfunding

When the firm uses the 'crowd' to obtain its funding, it has to describe the product and, as a result, to differentiate it with respect to the alternative products. This is modeled here by assuming that under crowdfunding, consumers know their exact location on the Hotelling line. It follows that consumer x's purchasing decision solves $\max_{i=1,2}\{r_i - \tau|l_i - x| - p_i\}$. For prices such that both products are sold, there is exactly one indifferent consumer $\widehat{x}$ who is defined by

$$
\begin{aligned}
r_1 - \tau\widehat{x} - p &= r_2 - \tau(1 - \widehat{x}) \text{ or, equivalently,} \\
\widehat{x} &= \frac{1}{2\tau}\left(\tau + r_1 - 1 - p\right).
\end{aligned}
$$

We check that $\widehat{x} \geq 0 \Leftrightarrow p \leq r_1 - 1 + \tau$ and $\widehat{x} \leq 1 \Leftrightarrow p \geq r_1 - 1 - \tau$. The demand of firm 1 consists of all consumers to the left of $\widehat{x}$ and thus, the demand function is

$$
Q_1(p) = \begin{cases}
0 & \text{if } p > r_1 - 1 + \tau, \\
\frac{1}{2\tau}\left(\tau + r_1 - 1 - p\right) & \text{if } r_1 - 1 - \tau \leq p \leq r_1 - 1 + \tau, \\
1 & \text{if } p \leq r_1 - 1 - \tau.
\end{cases}
$$

Whatever the status of the firm, the price is chosen so as to maximize $pQ_1(p)$. The first-order condition is $\tau + r_1 - 1 - 2p = 0$, which yields $p = \frac{1}{2}\left(\tau + r_1 - 1\right) \equiv p_C$. We have an interior solution provided that $p_C \geq r_1 - 1 - \tau$, which is equivalent to $3\tau \geq r_1 - 1$. In this case, the identity of the

indifferent consumer is found as $\hat{x} = (\tau + r_1 - 1)/(4\tau)$. This consumer gets a non-negative utility when purchasing either product as long as $3\tau \le r_1 + 3$, which is compatible with $3\tau \ge r_1 - 1$. If $3\tau > r_1 + 3$, firm 1 becomes a monopolist; the marginal consumer is located at $\tilde{x}$ such that $r_1 - \tau\tilde{x} - p = 0$ or $\tilde{x} = (r_1 - p)/\tau$. The optimal price is then easily found as $p = r_1/2$ and $\tilde{x} = r_1/(2\tau)$. Finally, if $3\tau < r_1 - 1$, then the entrepreneur sets $p = r_1 - 1 - \tau$ and all consumers buy from firm 1. We can then express profits at the optimal price as

$$
p_C Q_1(p_C) = \begin{cases} \frac{r_1^2}{4\tau} & \text{if } 3\tau > r_1 + 3, \\ \frac{(\tau + r_1 - 1)^2}{8\tau} & \text{if } r_1 - 1 \le 3\tau \le r_1 + 3, \\ r_1 - 1 - \tau & \text{if } 3\tau < r_1 - 1. \end{cases}
$$

As for the choice of quality, the status of the firm matters. Assuming for now that $r_1 - 1 \le 3\tau \le r_1 + 3$, the entrepreneur of a **non-profit** firm faces the following maximization problem:

$$
\max_{r_1} d\left(\frac{(\tau + r_1 - 1)^2}{8\tau} - \frac{\gamma}{2}r_1^2\right) + b(r_1 - 1).
$$

The first-order condition gives

$$
\frac{1}{4\tau}\left(4b\tau + d\tau - d + r_1(d - 4d\tau\gamma)\right) = 0 \Leftrightarrow r_1 = \frac{(4b + d)\tau - d}{d(4\tau\gamma - 1)} \equiv r_{NC}.
$$

From our previous analysis, we expect the chosen quality to increase when d decreases. We therefore assume

$$
4\tau\gamma > 1. \tag{12}
$$

The entrepreneur's utility is then equal to

$$
U_{NC} = \frac{\gamma(\tau - 1)^2 d^2 - 2\tau b(4\gamma - 1)d + 4b^2\tau}{2d(4\tau\gamma - 1)}. \tag{13}
$$

Note that we are in the conditions for an interior solution as long as $r_{NC} - 1 \le 3\tau \le r_{NC} + 3$, which can be rewritten as

$$
\frac{(4b + d)\tau - d}{d(4\tau\gamma - 1)} - 1 \le 3\tau \le \frac{(4b + d)\tau - d}{d(4\tau\gamma - 1)} + 3.
$$

As above, the optimal quality and utility for a **for-profit** entrepreneur is simply found by setting $d = 1$ in the previous expressions. We get

$$
r_{FC} \equiv \frac{(4b + 1)\tau - 1}{4\tau\gamma - 1} \text{ and}
$$

$$U_{FC} = \frac{\gamma (\tau - 1)^2 - 2\tau b (4\gamma - 1) + 4b^2 \tau}{2 (4\tau\gamma - 1)}. \tag{14}$$

We check that under assumption (12), the Glaeser-Schleifer result still holds under crowdfunding: a non-profit entrepreneur delivers a higher quality than a for-profit entrepreneur:

$$r_{NC} - r_{FC} = \frac{(4b + d) \tau - dr_2}{d (4\tau\gamma - 1)} - \frac{(4b + 1) \tau - r_2}{4\tau\gamma - 1} = \frac{4 (1 - d) b\tau}{d (4\tau\gamma - 1)} > 0.$$

4.3 Choice of funding and status

We start by comparing the firm's status under each funding mechanism. Comparing expressions (9) and (10), we observe that the entrepreneur choosing external funding prefers the non-profit status as long as

$$
\begin{aligned}
U_{NE} &> U_{FE} \Leftrightarrow \frac{1 - d}{2\gamma d} \left(2d\gamma - d + b^2\right) > 0 \\
&\Leftrightarrow b^2 > d (1 - 2\gamma).
\end{aligned}
\tag{15}
$$

As, realistically, the non-profit status cannot always be chosen under external funding, we posit that

$$\gamma < \frac{1}{2}. \tag{16}$$

As for crowdfunding, we compare expressions (13) and (14) , and find that the entrepreneur prefers a non-profit over a for-profit status provided that

$$
\begin{aligned}
U_{NC} &> U_{FC} \Leftrightarrow \frac{(1 - d) \left(2d\tau\gamma - d\gamma + 4b^2\tau - d\tau^2\gamma\right)}{2d (4\tau\gamma - 1)} > 0 \\
&\Leftrightarrow b^2 > \frac{1}{4\tau} (\tau - 1)^2 d\gamma.
\end{aligned}
\tag{17}
$$

The comparison of conditions (15) and (17) reveals that crowdfunding is more likely to lead to the choice of the non-profit status than external funding if

$$d (1 - 2\gamma) > \frac{1}{4\tau} (\tau - 1)^2 d\gamma \Leftrightarrow \gamma < \frac{4\tau}{6\tau + \tau^2 + 1} \equiv \hat{\gamma}.$$

We check that $\hat{\gamma} < \frac{1}{2}$, meaning that either cases are possible under assumption (16); we also check that $\gamma < \hat{\gamma}$ is compatible with assumption (12) (i.e., $4\tau\gamma > 1$) as long as $\tau > 0.527$. We have thus established the following result.

Proposition 2 *In situations where crowdfunding is used to reveal their preference to the consumers regarding the horizontal attribute of a product, crowdfunding is more likely than external funding to lead to the choice of the non-profit status if the cost of providing higher quality (γ) is small enough and if the degree of horizontal product differentiation (τ) is large enough. More precisely, this is so if*

$$\gamma < \frac{4\tau}{6\tau + \tau^2 + 1} \ and \ \tau > 0.527.$$

5 Concluding remarks

(To be written)

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