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Customer Segmentation Strategy of Crowdfunding Platform with Completion Time Uncertainty

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Completed Research Paper

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Abstract

While crowdfunding allows firms to raise external capitals from a large group of audience, firms are often unable to control their production process, and the project may fail without being completed on time. Having this in mind and knowing that consumers are heterogeneous in accepting late completion, fundraising firms often offer multiple reward plans to do customer segmentation to maximize the fund they may raise. Popular segmentation tools include early shipment promise and refund policy. Using a game-theoretic model, we show that the firm should adopt one of the two screening tools, but not both. Which tool a fundraising firm should choose is also examined. Our conclusions offer insights into managerial decisions for firms using crowdfunding in their early project development.

Keywords: crowdfunding, completion time uncertainty, early shipment promise, refund policy, customer segmentation.

Introduction

In recent years, crowdfunding has been a trend in capital raising for firms in their early stage. Many people launch their projects on several famous crowdfunding platforms such as Kickstarter in the U.S. and FlyingV in Taiwan. More than ten million people have backed projects through the Kickstarter online platform with pledged over 2.2 billion dollars.[1] Moreover, without capital cost and inventory risk, firms are motivated to create their project on crowdfunding platforms before any product is physically made. All of these advantages make crowdfunding popular in today's economy.

When a project is launched on the platform, the firm would design various reward plans and announce an estimated production schedule to attract backers (i.e., investors). However, many projects cannot complete their production schedule as promised and thus delay the shipment, typically due to a disruption at the supply side. For example, a famous project CatFi on the Indiegogo online platform underestimated its operational capital level and failed to fulfill their shipments with delaying by at least nine months.[2] Taiwanese record-breaking team Flux, who makes highly customizable and extendable 3D printers, also suffered from unexpected massive production problems. After admitting late shipment,

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[1] http://www.kickstater.com.

[2] http://www.indiegogo.com/pro jects/bistro-a-smart-feeder-recognizes-your-cat-s-face.

Flux refunded those who do not want to wait. It finally completed the project six months later than the originally promised deliver time.[3] As this supply disruption may harm investors, potential investors may be hesitate to invest in crowdfunding projects.

Given these uncertainties in mind, it is important for a firm to design its reward menu to use different options to attract different investors and maximize its expected profit. Naturally, investors are heterogeneous in their eagerness of obtaining the product early. In this study, we say investors have different patience levels, where more impatient investors want to obtain the product earlier. Therefore, a firm may offer multiple options (with various prices) to potential investors to do customer segmentation. One popular way to differentiate investors is to offer two options over shipment times. By doing so, an investor may pay more in exchange of an early shipment promise. If the project fails and cannot meet the schedule, all investors receive the product after the product is completed. However, if the project is completed in time, only those who purchased early shipment promise obtains the product early. Alternatively, a firm may allow an investor to spend extra money to purchase a refund option so that a full refund can be requested once the firm failed to ship at the promised time. Note that the benefit of buying the early delivery privilege is of course affected by the production uncertainty. Therefore, a firm may even combine the two policies to form the third differentiation strategy. In this study, we examine the profitability of these three possible pricing strategies.

The rest of paper is organized as follows. In the next section, we date back to articles related to our study. The Model section gives the general framework for the analysis. The Analysis section presents the results and discusses several implications and extensions of the results. We then investigate the initial capital requirement in the next section. Summaries are provided in Conclusions. Due to the page limit, proofs of lemmas and propositions are omitted. Interested readers may contact the authors to request the proofs.

Literature review

What leads to the success of crowdfunding has been an interesting issue and studied by many papers. Agrawal and Goldfarb (2014) study the reason why crowdfunding was not a meaningful method until the commercialization of the internet due to the lower search costs online, ability of small increments funding and lower communication costs. On the other hand, Gerber and Hui (2013) find that the funder motivation includes the desire to collect rewards, help others, support causes, and be part of a community. In addition, Mollick (2014) draws on a dataset of over 48,500 projects and suggests that personal networks and the underlying project quality are associated with the success of crowdfunding efforts. Moreover, even though the vast majority of founders seem to fulfill their obligations to funders, over 75% delivered products are later than expected. Therefore, the uncertain supply and possible supply disruption are serious issues in crowdfunding.

Literature on crowdfunding is relatively new and less extensive than general operations issues. Moritz and Block (2016) point out the challenges and several research directions of this rapidly growing area. The problem of the project creators' optimal menu design with the issue of adverse selection is related to our model. Belleflamme et al. (2015) further investigate the mechanism of the crowdfunding platform where the information asymmetry plays important role. Current research about information asymmetry of crowdfunding, Chang (2016) and Strausz (2015), focus on the mechanism of the project creator to transmit their product quality in dealing with the issue of moral hazard. However, our model aims to evaluate the optimal reward menu design problem with the information asymmetry not from the quality of product but from the variety of investors. Kumar et al. (2016) claim that the crowdfunding contracts may serve as a price-discrimination mechanism. Differs from the financing issues in Kumar et al. (2016), our approach is focus on the issue of screening contracting to the investors in order to elaborate the information feature of the crowdfunding activity.

Supply chain disruption has been widely discussed in the literature. Chopra and Sodhi (2004) indicates that potential supply-chain risks include delays, disruptions, forecast inaccuracies, systems breakdowns,

[3] http://www.kickstarter.com/pro jects/2117384013/flux-all-in-one-3d-printer-unlimited-elegant-simpl.

intellectual property breaches, procurement failures, inventory problems and capacity issues. Yu et al. (2009) and Tomlin (2006) study the optimal strategy facing unreliable suppliers and show that the optimal strategy selection depends on the percentage uptime and the nature of the disruption of the supplier. To the best of our knowledge, how a product producer under uncertain disruption may design a menu of different delivery time to maximize expected profit has not been discussed. This is the main focus of our study.

Because of the uncertainty of the product shipment time, many firms adopt refund policies to mitigate the risk of uncertainty and motivate the consumers to purchase. For example, Che (1996) studies the impact of the return policy on experience goods and find that consumers are strictly better off under the return policy. Mukhopadhyay and Setoputro (2004) develop a pricing strategy with return policy in e-business market and experience higher profit. Considering consumer regret, including inertia (delayed purchase) and frenzies (buying early at negative surplus), Chopra and Sodhi (2009) and Nasiry and Popescu (2011) show that the negative effect of regret on profit can be reduced by offering refunds. In our study, we also try to examine the benefit of introducing a refund policy in crowdfunding.

Model

In our model, we suppose there are a firm and several investors on the crowdfunding platform. In order to attract investors, the firm launches a crowdfunding project on the platform, including products information, reward program, and a completion schedule. However, under production uncertainty, the firm can only estimate the completion time instead of ensuring the exactly date. Thus, the firm should design its reward program to motivate investors to fund this risky project and maximize its profit. In this study, we analyze the profitability among different programs to find the best strategy for the firm.

We consider a crowdfunding environment that only exists one monopoly firm on the platform. This firm launches a crowdfunding project to produce products. Before the project is launched, the firm should design the menu of its funding project for investors to choose from.[4] There is a probability γ for the firm to complete the product in advance and the product can be shipped at the time t_E ahead of the estimated completion period. The standard shipment time is random in such lower bound $a > t_E$, upper bound b, with probability density function f and expected value. Let $\bar{t} = \gamma t_E + (1-\gamma) t_L$ be the expected shipment time.

To clarify the relation among parameters, we show the exact $\bar{t}$ in Figure 1. $\gamma = \frac{1}{7}$, $t_E = 1$, and the standard shipment time with uniform distribution between $[a, b] = [6, 10]$ are given. The expected value of the standard shipment time is thus $t_L = 8$. Then, the expected shipment time $\bar{t} = \gamma t_E + (1-\gamma) t_L = 7$.

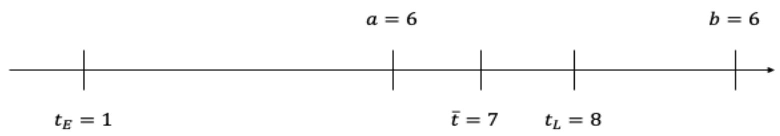

Figure 1. Numerical example of $\bar{t}$

Thus, the firm can decide whether to announce one extra early shipment time to investors with a different price. If the firm announces t_E, the firm may further decide whether to offer a refund policy. That is, if the firm fails to make shipment at the $t_E$as she promised, the investors will choose to refund the project to get their money back. Collectively, there are three types of reward contracts:

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[4] https://www.kickstarter.com/projects/2117384013/flux-all-in-one-3d-printer-unlimited-elegant-simpl/description.

The first one is LN (late with no refund) contract, which means the firm only commits to ship the products in between time a and time b. In this case, the expected shipment time will be t_L. Another contract called EN (early with no refund) contract, the one that the firm commits early shipment time t_E, without a refund policy. The last contract we also consider is ER (early with refund) contract. The firm commits early shipment time $t_E$with a refund policy.

The intrinsic product value to all investors is v. We assume patience-heterogeneous investors on the platform. There are two types of impatience level $\theta_1 < \theta_2$ with α and $1 - \alpha$ proportion of investors, respectively. That is, type θ_1 investors are more patient than type θ_2 investors. For simplicity to the notations, p_1 is the price of the contract that the firm wants to offer to type θ_1, p_2 vice versa. If an investor chooses LN contract, his utility will be

$$u^{LN}(\theta) = v - p - \theta t_L,$$

where p is the price of the reward contract. This investor will only expect to get the product at tL, and his patience type θ weighs this disutility.

Assumption 1. *For the disutility, we assume that*

$$\theta_2 t_E < \theta_1 t_L$$

for the following discussion. Impatient people with early shipment should have less disutility compare to patient people with late shipment.

If an investor chooses to get the product at t_E, there is a probability 1−γ that the product will only be delivered in the standard time period. If an investor enters into EN contract, his expected utility is

$$u^{EN}(\theta) = v - p - \theta(\gamma t_E + (1 - \gamma)t_L) = v - p - \theta\bar{t}.$$

There is probability γ that he gets the product at t_E, thus the disutility is θt_E. In the other case, he gets the product at t_L with probability $1 - \gamma$. The last is ER contract with investor's expected utility

$$u^{ER}(\theta) = \gamma(v - p - \theta t_E).$$

Though there is a chance shipping in the standard time period same as EN contract, investor will refund and get no payoff.

According to the revelation principle (Bolton and Dewatripont, 2005), an optimal menu should contain two incentive compatible contracts. We therefore analyze the following three strategies of offering a menu: The first is Time-screening strategy, which offering EN contract and LN contract. The second is Refund-screening strategy, offering ER contract and EN con- tract. And the other one is Dual screening strategy, which offer ER contract and LN contract.

And the firm and investors interact according to the following decision timing: First, the firm designs its menu of crowdfunding project. Second, investors choose one contract of reward menu to invest in or leave. In addition, the shipment uncertainty is realized, and the investor choosing ER contract can decide whether refund the product or not. Last but not least, all players get payoff.

Analysis

Optimal Reward Menus

In the time screening strategy, the firm offers LN contract to θ_1 investors and EN contract to $\theta_2$investors. Since the firm does not offer refund policy, money earns from both type is certain. Thus, her profit function under the time-screening strategy is

$$
\begin{aligned}
\max_{p_1,p_2} \quad & \alpha(p_1 - c) + (1-\alpha)(p_2 - c) & \\
\text{s.t.} \quad & v - p_2 - \theta_2 \bar{t} \geq 0 & \text{(T-IR2)} \\
& v - p_1 - \theta_1 t_L \geq 0 & \text{(T-IR1)} \\
& v - p_2 - \theta_2 \bar{t} \geq v - p_1 - \theta_2 t_L & \text{(T-IC2)} \\
& v - p_1 - \theta_1 t_L \geq v - p_2 - \theta_1 \bar{t}. & \text{(T-IC1)}
\end{aligned}
$$

She has to make sure both that the patient type θ_1 investors not to deviate to EN contract and that the impatient θ_2 investors will not enter LN contract based on their expectation. Then we obtain

Lemma 1. *The equilibrium prices in time-screening menu are*

$$p_1^T = v - \theta_1 t_L - (\theta_2 - \theta_1)\bar{t} \text{ and } p_2^T = v - \theta_2 \bar{t}$$

for LN and EN contracts, respectively. In addition, we have $p_2^T > p_1^T$, and the firm earns the profit

$$\pi^T = \alpha(v - \theta_1 t_L - (\theta_2 - \theta_1)\bar{t} - c) + (1-\alpha)(v - \theta_2 \bar{t} - c).$$

For type θ_2 investors, since they are more impatience than type θ_1 ones, they will get zero net utility eventually. Conversely, type θ_1 investors earns patience rent $(\theta_2 - \theta_1)\bar{t}$ based on the difference between their patience levels. Thus, when the difference becomes lager, this waiting value is more valuable. However, the price will be forced to rate at lower level properly in order to motivates both investors.

In refund-screening, the firm offers EN contracts to patient θ_1 investors and ER contract to impatient θ_2 investors. Since there is γ chance that the firm fails to ship on the early promised time t_E, the money will return to type θ_2 investors as rights in ER contract. Thus, the firm's expected profits function goes to

$$
\begin{aligned}
\max_{p_1,p_2} \quad & \alpha(p_1 - c) + (1-\alpha)(\gamma p_2 - c) & \\
\text{s.t.} \quad & \gamma(v - p_2 - \theta_2 t_E) + (1-\gamma)\max\{0, v - p_2 - \theta_2 t_L\} \geq 0 & \text{(R-IR2)} \\
& v - p_1 - \theta_1 \bar{t} \geq 0 & \text{(R-IR1)} \\
& \gamma(v - p_2 - \theta_2 t_E) + (1-\gamma)\max\{0, v - p_2 - \theta_2 t_L\} \geq v - p_1 - \theta_2 \bar{t} & \text{(R-IC2)} \\
& v - p_1 - \theta_1 \bar{t} \geq \gamma(v - p_2 - \theta_1 t_E) + (1-\gamma)\max\{0, v - p_2 - \theta_1 t_L\}. & \text{(R-IC1)}
\end{aligned}
$$

Since there is possible that the firm may not to offer refund considering shipment rate is too low, then this refund screening strategy will reduce to the single contract. Avoiding this situation, we suppose a condition

$$\gamma \geq \frac{(1-\alpha)v + \alpha\theta_1 t_L - \theta_2 t_L}{(1-\alpha)v + \alpha\theta_1 t_L - \theta_2 t_E}$$

for all environment. Subsequently, the firm's optimal pricing in this menu is as follows.

Lemma 2. *The equilibrium prices in refund-screening menu are*

$$p_1^R = v - \theta_1 \bar{t} - (\theta_2 - \theta_1)\gamma t_E \text{ and } p_2^R = v - \theta_2 t_E$$

for LN and EN contracts, respectively. Moreover, we have $p_2^R > p_1^R$, and the firm earns the profit

$$\pi^R = \alpha(v - \theta_1 \bar{t} - (\theta_2 - \theta_1)\gamma t_E - c) + (1-\alpha)(\gamma(v - \theta_2 t_E) - c).$$

For type θ_1 investors, they choose to endure the risk at failure of early shipment. To compensate this risk, type θ_1 investors have positive net utility compared to zero net utility of type θ_2 investors who will enter ER contract with the right to refund.

Now, there is another menu for the firm. We consider the dual screening strategy, which is the menu contains contract ER and contract LN. The firm offers LN contract to the type θ_1 investors and ER contract to the impatient type θ_2. Based on previous strategies, the firm's profit functions is

$$\begin{aligned}
\max_{p_1,p_2} \quad & \alpha(p_1-c)+(1-\alpha)(\gamma p_2-c) & \\
\text{s.t.} \quad & \gamma(v-p_2-\theta_2 t_E)+(1-\gamma)max\{0,v-p_2-\theta_2 t_L\}\geq 0 & \text{(D-IR2)}\\
& v-p_1-\theta_1 t_L \geq 0 & \text{(D-IR1)}\\
& \gamma(v-p_2-\theta_2 t_E)+(1-\gamma)max\{0,v-p_2-\theta_2 t_L\}\geq v-p_1-\theta_2 t_L & \text{(D-IC2)}\\
& v-p_1-\theta_1 t_L \geq \gamma(v-p_2-\theta_1 t_E)+(1-\gamma)max\{0,v-p_2-\theta_1 t_L\}. & \text{(D-IC1)}
\end{aligned}$$

Lemma 3. *The equilibrium prices in dual screening menu are*

$$p_1^D = v-\theta_1 t_L-(\theta_2-\theta_1)\gamma t_E \text{ and } p_2^D = v-\theta_2 t_E$$

for LN and ER contracts respectively. Moreover, we have $p_2^D > p_1^D$. The equilibrium profit for the firm is

$$\pi^D = \alpha(v-\theta_1 t_L-(\theta_2-\theta_1)\gamma t_E - c)+(1-\alpha)(v-\theta_2 t_E-c).$$

As a result, type θ_2 investors choose the ER contract as long as their utility is non-negative when they receive the product in time t_E. Thus, profit earned from type θ_2 is same as that in the refund-screening menu. On the other hand, for type θ_1 investors, the firm has to compensate them for choosing LN contract rather than ER contract, the concept of giving up the refund right and the waiting time. According to this compensation, type θ_1 investors once again obtain non-zero utility. More importantly, the price for type θ_1 in dual screening menu is lower than the price in refund-screening menu. This comparison allows us to obtain our first main finding.

Proposition 1. *For the firm to maximize her expected profit, refund-screening strategy always dominates dual screening strategy.*

Since the firm faces the same profit function, same optimal price p_2 to type θ_2, and rather lower p_1^D in dual screening menu, the firm earns less in dual screening strategy. This finding implies that the firm never offers dual screening menu in any environment. In other words, though there are two screening tools, shipment time and the right of refund, for the firm to take advantages to both groups of investors, the firm should just adopt on of them. Intuitively, since ER contract can attract type θ_2 investors, there is no motivation for the firm offering LN contract to type θ_1 with compensating waiting time but without increasing the profit. That is, the firm pays more cost in dual screening menu but earns nothing more than refund screening.

Optimal Strategy

In this section, we focus on the comparison between time-screening and refund-screening. In the discussion, we find that the parameters related to the firm, t_E, γ, θ_1, and θ_2 affect the menu selection. Therefore, we summarize our findings in the following.

We first identify an explicit threshold with respect to for the firm to prefer refund-screening or time-screening in Proposition 2. A visualization is presented in Figure 2.

Proposition 2. $\pi^R > \pi^T$ *if and only if* $\alpha > \frac{(1-\gamma)(v-\theta_2 t_L)}{\gamma(t_L-t_E)\theta_1+(1-\gamma)(v-\theta_1 t_L)}$.

When the firm offers refund-screening menu, the proportion of patient type θ_1 increases its profit since the volume of refund is moderated. That is, since the patient investors will pay more in the refund-screening menu, the firm has incentive to offer them early time contract EN, the expected loss of refund will be smaller. Thus, with higher α, the firm should choose refund- screening menu. Counter-intuitively, when the patient type θ_1 investors becomes more willing to suffer the waiting time with given proportion, the firm tends to choose refund-screening but time-screening. The reason is that although the lager difference of patience may implies better impact on time-screening, but this strategy costs too much for the firm to adopt it with compensating patient type investors. In fact, it can be proved that when the firm can always ship on time i.e., $\alpha = 1$, refund-screening always has higher profit than time-screening.

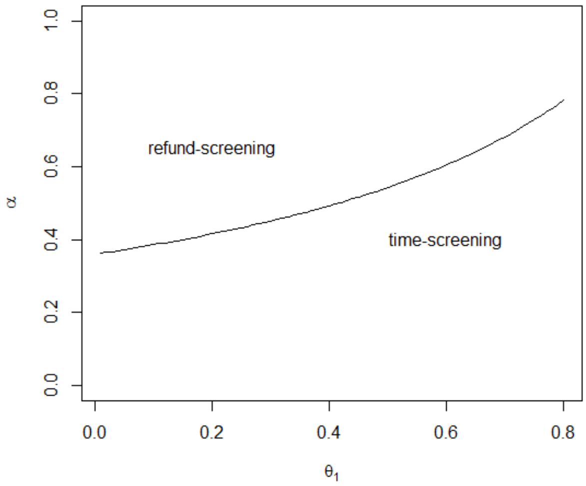

Figure 2. Comparison between pricing strategies with respect to α

Corollary 1. *The difference of profit under return-screening and time-screening, $\pi^R - \pi^T$, increases in γ and decreases in t_E.*

The first fact that $\pi^R - \pi^T$ increases in γ is verified in Corollary 3. Such monotonicity implies the existence of that unique threshold presented above. Interestingly, t_E affects the threshold (cf. Figure 2). As t_E increases, the time difference between early and standard estimated shipment decreases, which is the cost of the firm to compensate patient investors. That is, the firm can earn more since they only need to give less incentives to type t1 investors to choose EN contract when time difference is small. Therefore, the firm prefers time-screening menu.

We next discuss the impacts of impatience levels θ_1 and θ_2 on the threshold. We start from θ_2, the impatience level of impatient investors. Proposition 2 and Figure 3 summarize our findings.

Corollary 2. *The difference of profit under return-screening and time-screening, $\pi^R - \pi^T$, increases in θ_2.*

Higher θ_2 means the impatient investors become more impatient, and the difference of patience level between two groups increases. Since the firm earns less from the more impatient group, the firm should focus on the patient group. That is, the profit coming from type θ_1 investors take greater importance in the total profit for the firm. As discussed above, price for patient investors is higher in refund-screening menu. Thus, the firm will be more likely to choose refund-screening menu. This can be observed in Figure 3, as the threshold is shifted below by increasing θ_2.

Finally, we investigate the impact of γ on the optimal strategy.

Corollary 3. *The difference of profit under return-screening and time-screening, $\pi^R - \pi^T$, increases in γ .*

A visualization of the impact of γ is provided in Figure 4. This finding can also be explained by looking at the importance of the chance to ship in early promised time. When γ is large, risk of promise failure becomes less. It then follows that refund-screening is more reasonable and optimal. On the contrary, when γ is small, the chance of shipment disruption is larger, and the refund-screening strategy, which may incur refunds upon earlier shipment failure, then refund-screening becomes less attractive.

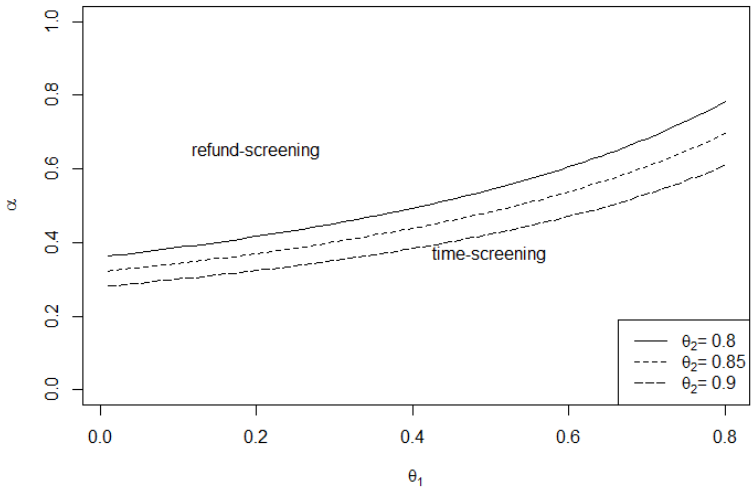

Figure 3. Impact of θ_2 on the threshold

A brief summarization of impacts of parameters are listed in Table 1.

Table 1. A Sample Table

parameter	$\pi^R - \pi^T$
γ	increase
t_E	decrease
θ_1	increase iff $\gamma > \frac{t_L}{2t_L - t_E}$
θ_2	increase
α	increase

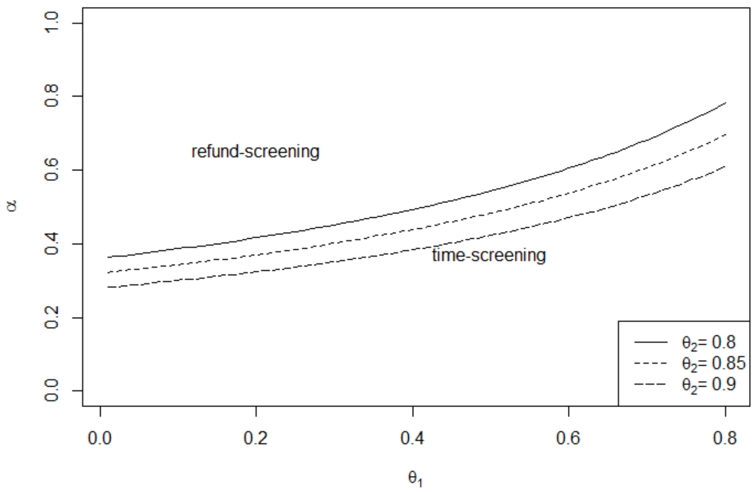

Figure 4. Impact of γ on the threshold

Initial Capital Constraint

In this section, we take the initial capital constraint into consideration. Lacking of operation capital is common phenomena for start-ups or small-size business on the crowdfunding platform. Therefore, in this section we consider the impact of initial capital requirement on the optimal strategy of our crowdfunding platform.

Suppose that there is an initial capital requirement K for the fundraising firm. That is, only when the initial received fund exceeds K can the firm start their operation and production. Thus, we define the initial fund for the two strategy considered, F^T for time-screening menu and F^R for refund-screening strategy. Clearly, the initial fund is the revenue from both type investors before facing refund situation. Hence, we obtain the F^T and F^R,

$$F^T = \alpha p_1^T + (1-\alpha)p_2^T$$
$$F^R = \alpha p_1^R + (1-\alpha)p_2^R$$

Moreover, $F^T > F^R$ at any case. Thus, we suppose $K < F^R$ to avoid uninteresting case. Then the decision problem for the firm becomes to

$$\max_{i\in\{T,R\}} \quad \pi^i$$
$$\text{s.t.} \quad F^i \geq K.$$

Firstly, it is obvious that if K small enough that both F^T and F^R can exceed, then the process for firm to form optimal strategy is same as Section 4. Thus, small K has no effect on the firm's optimal decision. However, we may take more emphasis on the situation that K is large enough to have impact on the decision process. Since $F^T > F^R$, the case that $\pi^T > \pi^R$ still be the optimal strategy for the firm. Specifically, the only condition different from Section 4 is that the net profit of time-screening strategy is the highest but the initial fund requirement prevent the firm choosing time-screening strategy. The decision-related K is as following

$$\pi^T \geq \pi^R$$
$$F^T < K$$

Thus, we obtain our next finding

Proposition 3. *Refund-screening is optimal when*

$$\alpha > \frac{(1-\gamma)(v-\theta_2 t_L)}{\gamma(t_L - t_E)\theta_1 + (1-\gamma)(v-\theta_1 t_L)}$$

or

$$K > v - \alpha\theta_1(t_L - \bar{t}) - \theta_2\bar{t}.$$

Compared to Proposition 2, the optimal regional for refund-screening may increase with initial capital requirement. This result implies that the firm may be forced to announce the refund policy while this policy is harm to its profit. Furthermore, it is possible that even though the probability of early shipment γ is small, the firm still offer refund policy under initial capital constraint. This finding may echo the phenomenon on the real world platform that start-ups offer refund option and" early bird" option but most of them fails to ship on time.

Figure 5 shows a more concrete view of the change of optimal decision under this capital-constraint environment. The optimal strategy, under higher θ_1 and equally-diverse group of investor, has become refund-screening rather than time-screening. That is, the price offering to the type θ_1 investor is forced to rate so low that the time-screening strategy cannot meet the initial capital requirement. Thus, only when the proportion of type θ_1, α, is small enough that the main revenue comes from the type θ_2 investors can the firm still adopt time-screening menu.

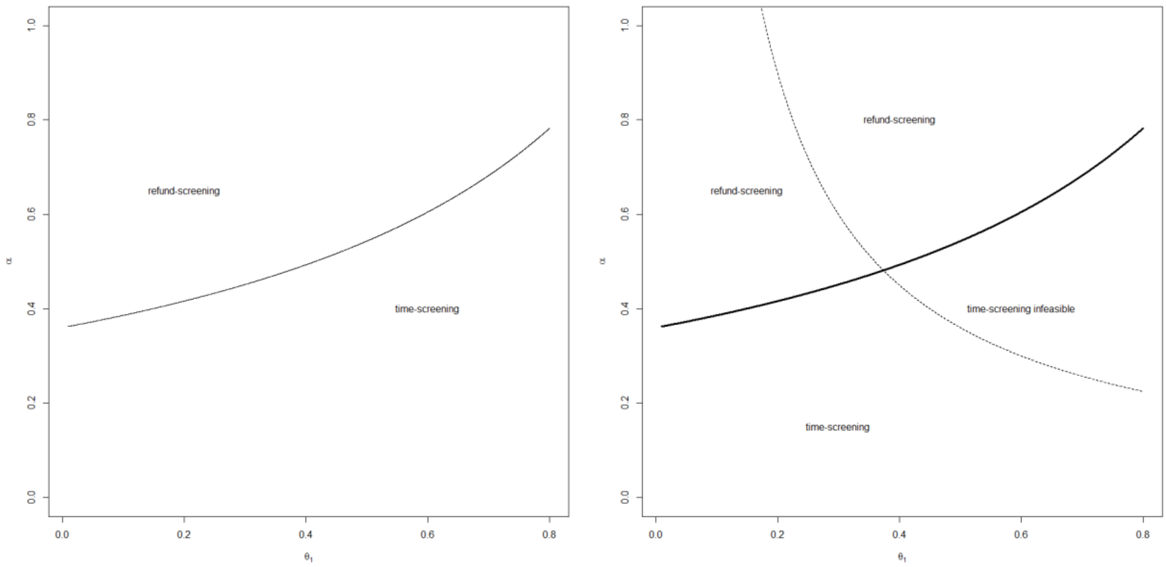

Figure 5. Impact of setting initial capital constraint

Moreover, Figure 6 investigates the impact of different initial capital requirement. Obviously, smaller capital requirement K has less impact on forcing firm to alter to refund screening menu from its optimal time-screening strategy. In business environment, the operations with substantial capital investment such as high-tech products may lead the firm to choose refund- screening strategy.

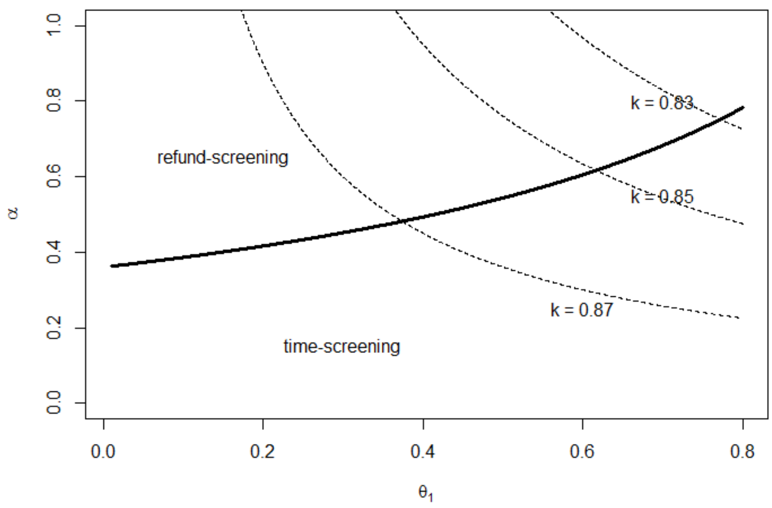

Figure 6. Impact of different initial capital constraint

Conclusions

The results presented here give several interesting managerial insights. With considering shipment time uncertainty, the firm should offer different screening menu based on its ability of early completion and the structure of investors. Moreover, if one of the two screening tools can effectively differentiate the markets, then the dual screening strategy containing early shipment with refund and standard shipment period will be dominated that harms the firms profit. Therefore, the firm should focus on designing its reward menu in crowdfunding project as important as on its manufacturing process. In some situation, the firm may promise offer the refund-screening strategy in order to maximize its profit even when they are lack of the ability to complete in time. Moreover, in high initial investment business environment the firm may be forced to offer the refund-screening menu to attain the required capital level. When considering the flexibility of announcing the early shipment time, the firm has to take serious research on the consumer structure and patience characteristic of the market rather than only take examine on the firm's failure early shipment risk.

For the future study, our model may be extended to consider the disutility of the promise failure. This effect represents that if investors choose early shipment and the firm fails its promise, investors suffer more than they have expected in the time of decision. Moreover, the risk of the fundraising failure of the project may also be considered in the model. We expect that there are several interesting insights for both the firm and investors making their decisions.

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