Bundling and Pricing Strategies in Crowdfunding

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Background

What's the reward-based crowdfunding in AoN mechanism?

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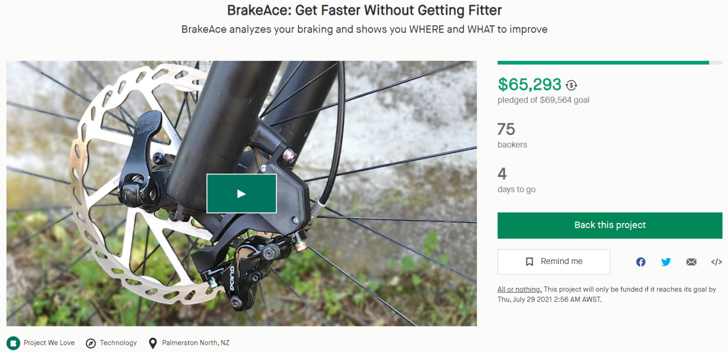

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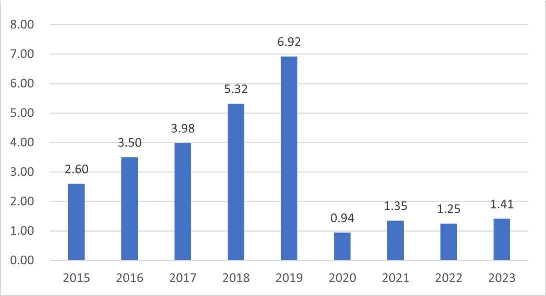

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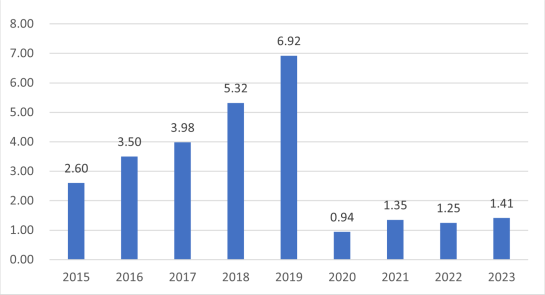

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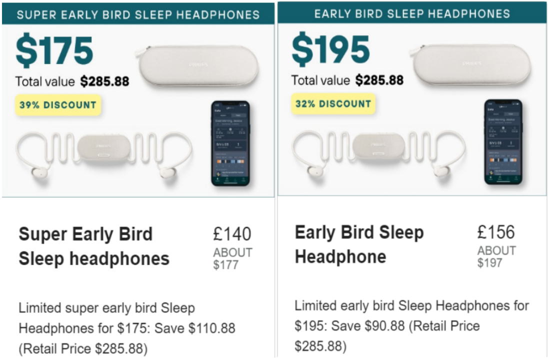

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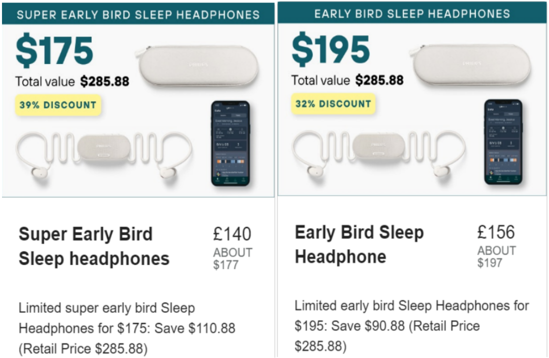

- The creator can offer a list of prices to stimulate pledging by the menu pricing strategy.

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This paper discusses two products fiancing in reward-based crowdfunding within AoN mechanism, and solves three problems.

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Research Question

This paper discusses two products fiancing in reward-based crowdfunding within AoN mechanism, and solves three problems.

1. The classical "to bundle or not to bundle" problem in crowdfunding.
2. What are key factors affecting the optimal choice of the pricing strategy?
3. How does the heterogeneity among multiple products influence the bundling and pricing strategies?

Research on Crowdfunding

Research on Crowdfunding

- **Mechanism design**:Belleflamme et al. (2014), Cumming et al. (2020), Belavina et al. (2020), Yang et al. (2020), Du et al. (2017), Peng et al. (2020).
- **Value of information**: Mollick (2014), Chemla and Tinn (2020), Chakraborty and Swinney (2020), Du et al. (2020).
- **Pricing policy**: Palmiter (2012), Hu et al. (2015) Luo et al. (2017), Chen and Liu (2017), Xu et al. (2018).
- **This paper compares two mechanisms in the crowdfunding with different pricing policies.**

Research on Bundling

Research on Bundling

- **Basic two-product model**:Adams and Yellen (1976), Schmalensee (1982), Venkatesh and Mahajaim (1993).
- **Large number of information products**:Hanson and Martin (1990), Yannis and Erik (1999), Fang and Norman (2006).
- **Bundling in related managerial topics**: Cao et al. (2019), Prasad et al. (2010).
- **This paper introduces the "to bundle or not to bundle" problem into the crowdfunding.**

Model Setup

- We develop a **two-period model** to study a risk-neural creator's crowdfunding strategies.

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- We develop a **two-period model** to study a risk-neural creator's crowdfunding strategies.
- The creator can set a **funding target** for its project and it will succeed if the pledged amount exceeds the target.
- The creator chooses among several **pricing policies** (Similar to the discussion by Hu et al. (2015)), and decides whether to **bundle** the two products together and raises a **single** campaign.

Model Setup

Assume that the two products are homogeneous, the valuation of product i follows the distribution.

Single Product:

$$V_i = \begin{cases} H & \text{with probability} \quad \alpha, \\ L & \text{with probability} \quad 1-\alpha, \end{cases}$$

Where $H > L > 0$, $\alpha \in (0,1)$, $i = 1,2$. V_i is independent across different backers for different products. H as the high-type, L as the low-type backer.

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A Bundle, $V_b = V_1 + V_2$

$$V_b = \begin{cases} 2H & \text{with probability} \quad \alpha^2, \\ H+L & \text{with probability} \quad 2\alpha(1-\alpha), \\ 2L & \text{with probability} \quad (1-\alpha)^2. \end{cases}$$

Pricing Policies

Draw on the most precedent theoretical works in pricing policies of crowdfunding (e.g., Cao et al. 2019, Hu et al. 2015, Prasad et al. 2010).

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- *Margin Pricing (M)*: the creator sets a high price that can only raise capital from high-type backers.
- *Volume Pricing (V)*: the creator sets a low price to raise funds from both types of backers.
- *Menu Pricing (N)*: the creator provides a price list for different backers to stimulate pledging.

Separate Funding (SF)

There are three scenarios: (1) both projects succeed (2) only one project succeeds (3) both projects fail.

The creator sets a price p_i, $i = 1, 2$ in the two periods.

Since the projects will succeed only if both backers sign up, the target is $T_i = 2p_i$.

Expected profit by "π" with subscript "s" and superscript "M", "V" and "N" for different pricing strategies.

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Margin Pricing (M)

- $p_i^M = H$, $i = 1, 2$, and the target is $T_i^M = 2H$.
- The expected total profit is $\pi_s^M = 4H\alpha^2$.

Separate Funding (SF)

Volume Pricing (V)

- $p_i^V = L$, $i = 1, 2$, and the target is $T_i^V = 2L$.
- The total expected revenue is $\pi_s^V = 4L$.

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Menu Pricing (N)

- A list of prices contain a high price p_i^H and a low price p_i^L, where $p_i^L \leq L \leq p_i^H \leq H$, the target $T_s^N = p_i^L + p_i^H$. item A high-type backer would prefer p_i^H over p_i^L, must satisfy IC_i:

$$\alpha(H - p_i^L) \leq H - p_i^H, \qquad (IC_i)$$

- The total expected revenue is $\pi_s^N = 2\alpha(2-\alpha)[(1-\alpha)H + (1+\alpha)L]$.

Bundle Funding (BF)

We assume that each backer will pledge no more than one bundle, and the campaign will succeed only if both backers pledge the bundle.

The consumers with different valuations towards the bundle as “HH-type”, “HL-type” and “LL-type” respectively.

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- $p_b^V = 2L$, and the target is $T_b^V = 4L$.
- The total expected revenue is $\pi_b^V = 4L$.

Bundle Funding (BF)

Intermediate pricing (I)

- $p_b^I = H + L$, and the target is $T_b^I = 2(H + L)$.
- The total expected revenue is $\pi_b^I = 2\alpha^2(2 - \alpha)^2(H + L)$.

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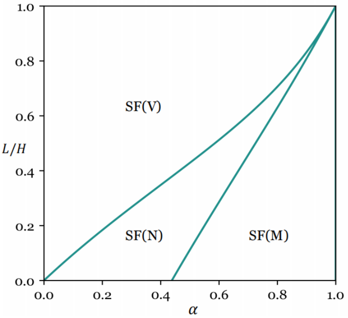
Menu Pricing (N)

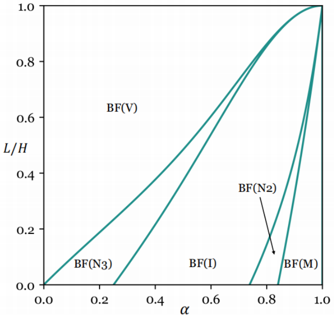
1. $p_b^L \leq 2L < H + L \leq p_b^H \leq 2H$, named as strategy N_1, $\pi_b^{N_1} = 2\alpha^2(2-\alpha^2)[(1-\alpha^2)H + (1+\alpha^2)L]$.
2. $2L < p_b^L \leq H + L \leq p_b^H \leq 2H$, named as strategy $N_2, \pi_b^{N_2} = \alpha^3(4-3\alpha)[(1-\frac{\alpha}{2-\alpha})2H + (1+\frac{\alpha}{2-\alpha})(H+L)]$.
3. $p_b^L \leq 2L \leq p_b^H \leq H + L$, named as strategy N_3, $\pi_b^{N_3} = [1-(1-\alpha)^4][(1-\alpha(2-\alpha))(H+L) + (1+\alpha(2-\alpha))2L]$.

Optimal Pricing Policies

Optimal Pricing Policies of Separate and Bundle Funding



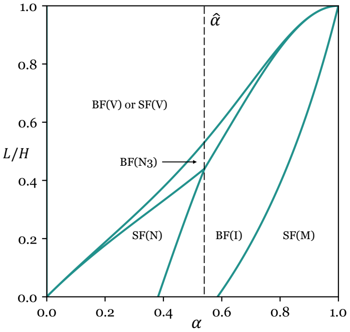
(a) Separate Funding



(b) Bundle Funding

The Comparison between Separate and Bundle Funding

Comparison Between SF and BF



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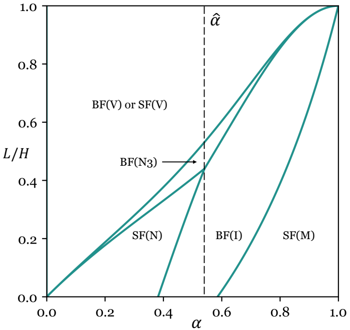

Optimal Pricing Strategy

	low α	slightly low α	slightly high α	high α
high L/H	SF(V) or BF(V)	BF(N_3)	BF(I)	SF(M)
low L/H	SF(V) or BF(V)	BF(N_3) or SF(N)	BF(I)	SF(M)

Denote $d_1 = \frac{\alpha^4-4\alpha^3+6\alpha^2-4\alpha}{\alpha^4-4\alpha^3+2\alpha^2+4\alpha-4}$, $d_2 = \frac{\alpha^4+4\alpha^3+9\alpha^2-10\alpha+2}{\alpha^4-4\alpha^3+\alpha^2+6\alpha-6}$, $d_3 = \frac{-\alpha^2+4\alpha-2}{\alpha^2-4\alpha+4}$, $d_4 = \frac{\alpha^3-3\alpha^2+4\alpha}{\alpha^3-3\alpha^2+4}$, $d_5 = \frac{-\alpha^2+3\alpha-1}{\alpha^2-\alpha+1}$. The value $\hat{\alpha}$ is obtained by solving the equation: $d_2 = d_5$ for $\alpha \in (0,1)$.

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1. Raising multiple campaigns can lower the risk of failure and maximize the expected profit if the fraction of one type of backers is high.
2. Bundling multiple products together and raise a single campaign can expand the market size to capture a significant return if the fraction of several different types of backers is balanced.
3. By the heterogeneity of backers, the creator can offer a menu of prices to achieve coordination among backers and thus raise the success rate.

Social Welfare and Buyer Surplus

Corollary 1

(i) For the separate funding, the social welfare of different pricing strategies follows the order: $W_s^M < W_s^N < W_s^V$, and the buyer surplus of different pricing strategies follows the order: $CS_s^M < CS_s^N < CS_s^V$.

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(ii) For the bundle funding, the social welfare of different pricing strategies follows the order: $W_b^M < W_b^{N_2} < W_b^I < W_b^{N_3} < W_b^V$, and the buyer surplus of different pricing strategies follows the order:
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$CS_s^M < CS_b^I < CS_s^N < CS_b^{N_3} < CS_b^V = CS_s^V$.

Substitutes and Complements

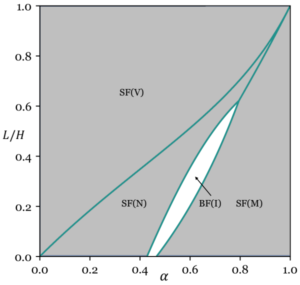
Backers' valuation towards the single product remains to be H and L but the valuation $\tilde{V}_b$ towards the bundle is assumed to be

$$\tilde{V}_b = \begin{cases} 2\theta H & \text{with probability} & \alpha^2, \\ \theta(H+L) & \text{with probability} & 2\alpha(1-\alpha), \\ 2\theta L & \text{with probability} & (1-\alpha)^2. \end{cases}$$

$\tilde{V}_b = \theta(V_1 + V_2)$,if $\theta \in [1/2, 1)$, the products are substitutes, and if $\theta \in (1, +\infty)$, the products are complements. (Proposed by Yannis and Erik (1999), page 1621)

Results and Analysis

To gain clear-cut results, we examine four cases : (a) $\theta = 0.7$ for strong substitution ; (b) $\theta = 0.85$ for weak substitution; (c) $\theta = 1.5$ for strong complementary ; (d) $\theta = 1.3$ for weak complementary.



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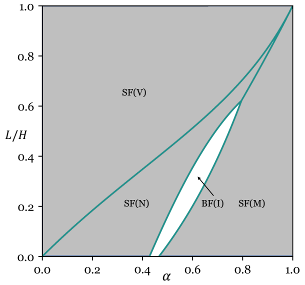

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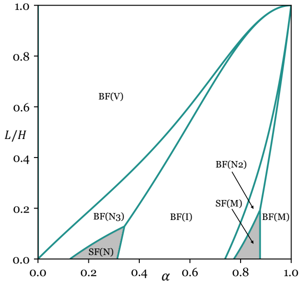

$\theta = 1.3$

Quality Differentiation

- We assume that the valuation of the two products is different in their average values by introducing the parameter $k \geq 0$. The random variables V_1 and V_2 are

$$V_1 = \begin{cases} H & \text{probability} \quad \alpha, \\ L & \text{probability } 1-\alpha, \end{cases} \qquad V_2 = \begin{cases} H+k & \text{probability} \quad \alpha, \\ L+k & \text{probability } 1-\alpha. \end{cases}$$

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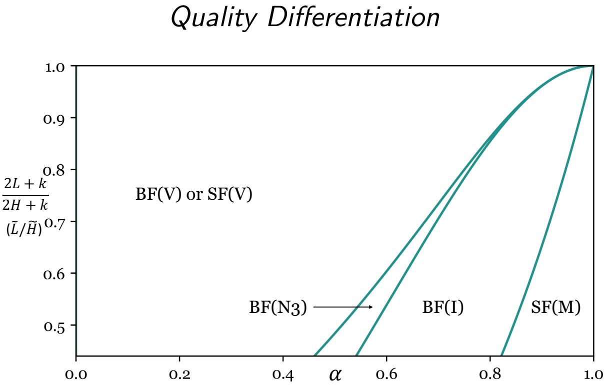
Therefore, the valuation of the bundle follows the distribution of V_b as

$$V_b = \begin{cases} 2H+k & \text{with probability} & \alpha^2, \\ H+L+k & \text{with probability} & 2\alpha(1-\alpha), \\ 2L+k & \text{with probability} & (1-\alpha)^2. \end{cases}$$

Results



Where $\frac{2L+k}{2}=\tilde{L}$, $\frac{2H+k}{2}=\tilde{H}$

Results

- The product with relatively high quality has a higher valuation ratio than the product with relatively low quality.
- By bundling the products with high and low quality together, the valuation of the bundle among different backers tends to be near.
- The backers with high valuations are optimal if the valuation ratio is low because the benefit of the high target is more significant than the shortcoming of the low success rate.

In that sense, the pricing strategy that benefited from the low valuation ratio will not be favored when promoting the product with high quality.

Results

Proposition 3

For any given $L/H \in (0,1)$ and $\alpha \in (0,1)$, if k is sufficiently high, the optimal pricing strategy is the volume strategy for separate or bundle funding.

Corollary 2

For any given $L/H \in (0,1)$ and $\alpha \in (0,1)$, if k is sufficiently high and the creator can set different pricing policies in separate funding, the separate funding weakly dominates the bundle funding.

Variance Differentiation

- The random variables V_1 and V_2, follows the two-point distribution as:

$$V_1 = \begin{cases} H & \text{probability} \quad \alpha_1, \\ L & \text{probability } 1 - \alpha_1, \end{cases} \qquad V_2 = \begin{cases} H & \text{probability} \quad \alpha_2, \\ L & \text{probability } 1 - \alpha_2. \end{cases}$$

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As a result, the valuation of the bundle follows the distribution:

$$V_b = \begin{cases} 2H & \text{with probability} & \alpha_1\alpha_2, \\ H+L & \text{with probability} & \alpha_1(1-\alpha_2)+\alpha_2(1-\alpha_1), \\ 2L & \text{with probability} & (1-\alpha_1)(1-\alpha_2). \end{cases}$$

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For (a), let $\alpha_1 = 1/2 + \delta$ and $\alpha_2 = 1/2 - \delta$, $\delta \in (0, 1/2)$. If δ is close to $1/2$, the α_1 is close to 1 and α_2 is close to 0.

For(a)

Proposition 4

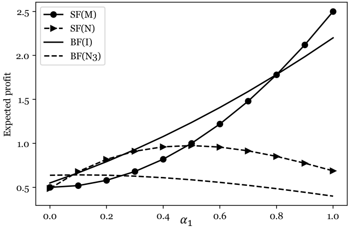
If $\delta \in (0, 1/2)$ is sufficiently high, the intermediate pricing strategy is optimal.

In real practice, if one product mainly serves the backers with a high valuation and the other serves the backers with a low valuation, bundling the two products together may encourage the backers with an intermediate valuation to sign up.

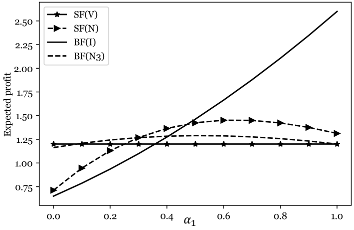
For(b)

We perform the numerical study to show the comparison if $\alpha_2 = 1/2$ and $\alpha_1 \in (0, 1)$ for $L/H = 0.1, 0.3, 0.7, 0.9$.

Comparison with $\alpha_2 = 1/2$ and low L/H



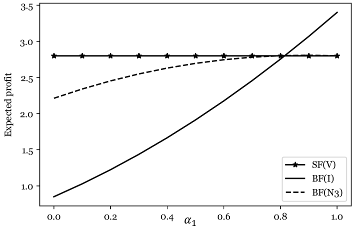
$L/H = 0.1$



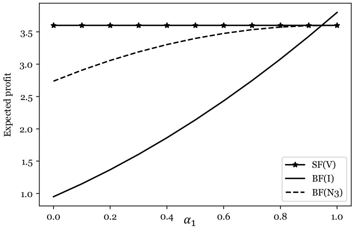
$L/H = 0.3$

For(b)

Comparison with $\alpha_2 = 1/2$ *and high* L/H



$L/H = 0.7$



$L/H = 0.9$

Conclusion

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2. The optimal menu pricing strategy of the separate and bundle funding can be optimal under different circumstances.
3. If the heterogeneity between the two products is high, the optimal pricing strategy depends on the valuation of the main product. Also, if the creator can set different pricing strategies for products with different qualities, separate funding weakly dominates.

THANK YOU!