Chapter 22
Products and Services Bundling Under Horizontal Market Competitions

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Abstract This paper investigates the impact of products and services bundling from the perspective of providers and customers by comparing the profit and consumer surplus under two scenarios where providers apply "fully compete" and "no bundle" strategies respectively. The result shows that higher customer value and congestion cost can benefit the providers under the "bundle ban" policy, while the service price greatly influences the profit distribution between products and services providers. Contrarily, the low customer value and congestion cost can benefit customers to some extent. Our study gives managerial insight to policymakers on how products and services bundling can achieve better social welfare under certain circumstances and help providers to execute proper strategies in a competitive market.

Keywords Products and services bundling · Horizontal market · Market competition

Introduction

In many industries, it is a common phenomenon that a customer demands both products and services. For example, a customer who purchases a home appliance will require installation service in the meantime. In the beauty industry, a customer may ask for make-up or skincare service after buying cosmetics. Also in the healthcare context, a patient needs both drugs and diagnosis sometimes. Interestingly, companies

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R. Qiu et al. (eds.), *City, Society, and Digital Transformation*, Lecture Notes in Operations Research, https://doi.org/10.1007/978-3-031-15644-1_22

in different industries apply different strategies in terms of products and services. An appliance company would like to bundle the installation service with the product while a beauty shop accepts customers bringing skincare product themselves and charge for the care service only. More than that, governments can have various attitudes toward the bundling of products and services. For instance, some countries allow health institutions to provide both products and services. Consider a patient's choice under a minor ailment: she can either visit a hospital and pay for prescriptions therein or visit a pharmacist directly who sometimes also provides diagnosis service. Whereas in other countries, the bundle of products and services is prohibited in the healthcare industry, such as the separation of prescribing and dispensing (SPD) policy in the United States.

Many studies have shown that the bundle of products is more profitable [1, 2]. However, the research on bundling of products and services is relatively rare. Wang et al. hold whether firms should offer bundles or products alone depends on the cost structure of the service and customers' sensitivity to service [3]. Moreover, it is not always beneficial to bundle products and services. In healthcare industries, the bundle of prescribing and dispensing may lead to the overuse of drugs and increase drug dispense [4]. On the other hand, the implementation of SPD can create monopoly situations where the price of products and services will be higher for customers.

Based on the above observations and the findings of the previous study, we forward the following research question: What influence will the bundling of products and services bring to providers and customers? What factors and how can they affect the welfare of providers and consumers? What strategy should providers apply in the different market environments? To investigate these questions, we provide a cost and benefit analysis for both bundling and separating strategies for providers, customers as well as social welfare in a competitive market. We consider a market consisting of two horizontally competing providers A and B, who are capable of providing both products and services. When facing competition from B, provider A can choose to apply either a "fully compete" strategy or a "no bundle" strategy. Under the first strategy, A competes in both products and services market and receives revenue therein. Under the second strategy, two providers specialize in either product or service delivery to avoid competition in both markets. We construct an analytical model to study providers' decisions under the two strategies and A's optimal bundling strategy. We also explore how the customer surplus and social welfare are affected by the bundling strategy.

The result shows that a low service price reduces A's profit under the bundle policy while a high service price benefits B under such policy. In a market with expensive labor costs, it is possible to achieve a win–win situation between A and B when customer valuation is high enough. On the other hand, customer surplus is higher under the "no bundle" strategy when the customer cares more about service quality than the product. Furthermore, we identify a situation where the government can prohibit the bundling strategy to redistribute social welfare and benefit customers by cutting the profit of providers.

The rest of this paper proceeds as follows. The second chapter reviews the current literature. Next chapter we introduce the model setup and conduct an equilibrium analysis. The fourth chapter is a comparison and discussion of the model. The last chapter summarizes the results.

Literature Review

Our study is mainly relevant to the literature on bundling. Adams and Yellen find bundling can be more profitable than simple monopoly pricing by extracting consumer surplus [1]. Venkatesh and Mahajan investigate different strategies (i.e., pure components, pure bundling, and mixed bundling) in performance ticket selling and obtain the result that mixed bundling is most profitable [2]. In a duopoly market, three equilibriums can be achieved, namely differentiated duopoly, monopoly, and perfect competition, depending on whether the firms choose to bundle or not [5]. The bundling strategy can be applied to various industries and conditions. Kameshwaran et al. state a manufacturing firm that intends to bundle its service with the product [6]. In terms of virtual goods, bundling very large numbers of unrelated information goods can be surprisingly profitable [7]. However, it is not always wise to apply bundle strategy. Whether firms should offer bundles or products alone depends on the cost structure of the service and customers' sensitivity to service [3].

Our work departs from the previous literature in two ways. First, we discuss products and services bundling in a horizontal market, where no asymmetry information occurs and all suppliers have the same capability to provide products and services. Second, we take into account the congestion cost in service, which is crucial in our model and generally overlooked in previous bundling literature.

Model Setup and Equilibrium Analysis

Consider a competitive market consisting of two providers A and B who can both sell products and provide services. We refer to a situation when the market is under a "bundle ban" policy if products and services bundling is prohibited. We use Scenario 1 to represent the case where bundling is not prohibited and the providers execute the "fully compete" strategy. In Scenario 2, two providers specialize in products and services respectively under the "bundle ban" policy, i.e. A sells products and B provides services.

We use ϕ to capture the probability of a customer in the requirement of the service. $u(\phi) = \phi(S + c\lambda)$ captures the dis-utility of receiving the service, where S is the service price, c is the congestion coefficient and λ is the equilibrium population who require the service. The market size is normalized to 1. A consumer is located at $x \in [0, 1]$, while provider A is located at $x_A = 0$ and B is located at $x_B = 1$. V, P, β captures the value, retail price, and unit transportation cost of the product respectively. All variables are exogenous except P. A consumer purchases the product if and only if her/his utility is non-negative, i.e., $U(x) \geq 0$.

Scenario 1: A Bundling and B Bundling

In this scenario, the bundle-ban policy does not exist and two providers can compete in both products and services. A consumer is flexible in buying products and receiving services from either A or B. Here we assume the capacity of providers A and B can fully cover the market demand. We use subscript i to denote company i, $i \in \{A, B\}$. A consumer will choose A's service if $u_A(\phi) \le u_B(\phi)$, and B's otherwise.

The sequence of events is as follows:

1. A and B decide the price of product P_A and P_B simultaneously.
2. Profits are collected.

A consumer's utility of purchasing the product from A or B is

$$U_A(x) = V - P_A - \beta x - u_i(\phi) \tag{22.1}$$

$$U_B(x) = V - P_B - \beta(1 - x) - u_i(\phi) \tag{22.2}$$

Let D_i be the number of customers who purchase the product from provider i. The production cost, selling cost, and service cost is normalized to zero. Then the profit of A and B is

$$\Pi_A^1 = P_A D_A + S_A \lambda_A \tag{22.3}$$

$$\Pi_B^1 = P_B D_B + S_B \lambda_B \tag{22.4}$$

The consumer surplus is

$$CS^1 = \int_{\substack{U_A(x) \ge U_B(x) \\ U_A(x) \ge 0}} U_A(x)dx + \int_{\substack{U_B(x) \ge U_A(x) \\ U_B(x) \ge 0}} U_B(x)dx \tag{22.5}$$

The results of the model are shown in the proposition below.

Proposition 1 There exists a unique equilibrium for the model in Scenario 1 where:

$$P_A = P_B = \beta, D_A = D_B = \frac{1}{2}$$
$$\Pi_A = \Pi_B = \frac{\beta + \phi S}{2}, CS^1 = V - \frac{5}{4}\beta - \phi S - \frac{1}{2}c\phi^2$$

The equilibrium shows that two providers share products and services market equally. The equilibrium price is irrelevant to customer value because of competition. Also, note that an increase in service price and transportation cost will lead to an increase in the provider's profit but a decrease in consumer surplus.

Scenario 2: A Product and B Service

Suppose a bundle-ban policy is implemented, which means a company can choose to provide either product or service but not both. Let's assume A sells the product only while B provides the service and a single provider cannot cover the whole market demand.

The sequence of events is as follows:

1. Provider A decides the price of the final product P.
2. Profits are collected.

A consumer's utility of consuming the product is

$$U(x) = V - P - \beta x - u(\phi) \tag{22.6}$$

The profit of providers A and B is

$$\Pi_A^2 = PD \tag{22.7}$$

$$\Pi_B^2 = S\lambda \tag{22.8}$$

The consumer surplus is

$$CS^2 = \int_{U(x)\geq 0} \mathrm{U}(x)dx \tag{22.9}$$

The results of the model are shown in the proposition below.

Proposition 2 There exist an optimal result for the model in Scenario 1 where:

$$P = \frac{V - \phi S}{2}, D = \frac{V - \phi S}{2(\beta + c\phi^2)}$$

$$\Pi_A^2 = \frac{(V - \phi S)^2}{4(\beta + c\phi^2)}, \Pi_B^2 = \frac{\phi S(V - \phi S)}{2(\beta + c\phi^2)}, CS^2 = \frac{\beta(V - \phi S)^2}{8(\beta + c\phi^2)^2}$$

Proposition 2 shows the optimal price for provider A is determined by customer value and service price. A higher customer value and lower service price can increase provider A's profit and customer surplus but may be detrimental to B's benefit.

Comparison and Discussion

In this section, we compare the results of two scenarios from the perspective of A's profit, B's profit, aggregate profit, and consumer surplus.

Lemma 1 The comparison result can be divided into six cases in terms of profit (Table 22.1):

(i)$\Pi_A^1 \langle \Pi_A^2, \Pi_B^1 \rangle \Pi_B^2, \Pi^1 < \Pi^2 if and only if V_5 < V < \min\{V_2, V_4\}$;
(ii)$\Pi_A^1 < \Pi_A^2, \Pi_B^1 < \Pi_B^2, \Pi^1 < \Pi^2 if and only if \max\{V_3, V_4\} < V < V_2$;
(iii)$\Pi_A^1 > \Pi_A^2, \Pi_B^1 < \Pi_B^2, \Pi^1 < \Pi^2 if and only if V_5 < V < \min\{V_2, V_3\}$;
(iv)$\Pi_A^1 \langle \Pi_A^2, \Pi_B^1 \rangle \Pi_B^2, \Pi^1 > \Pi^2 if and only if \max\{V_1, V_3\} < V < V_5$;
(v)$\Pi_A^1 > \Pi_A^2, \Pi_B^1 > \Pi_B^2, \Pi^1 > \Pi^2 if and only if V_1 < V < \min\{V_3, V_4\}$;
(vi)$\Pi_A^1 > \Pi_A^2, \Pi_B^1 \langle \Pi_B^2, \Pi^1 \rangle \Pi^2 if and only if \max\{V_1, V_4\} < V < V_5$.

Lemma 1 shows that for high V(i.e., $V > V_5$), the aggregate profit of A and B is higher under the bundle prohibited scenario. Notice in Scenario 2, the optimal retail price and demand of the product are both positively correlated with customer demand and negatively correlated with service price. A larger customer value implies more purchase intention of products, and providers can take the opportunity to realize a higher profit by sufficient customer demand and high product price. Meanwhile, the service price will influence the allocation of profit between A and B. Specifically, provider A which sells the product benefits from the bundle ban policy only when S is not too large, while B benefits from the policy only when S is large enough. When the service price is small, provider B's profit is decreased while A's is increased. This is intuitive as a lower service price indicates a smaller profit margin for the service provider. Hence B will gain less profit from providing the service in Scenario 2. However, the market demand and product price will increase as the service price goes down. As a result, the profit of A will increase. When S is large, A has to reduce the product price in order to guarantee the product is still attractive enough for customers to purchase. Hence, A will obtain less profit from selling the product in Scenario 2 than providing both products and services in Scenario 1, while B can earn a higher proportion of profit on the contrary. Therefore, the prohibition of bundling will harm the profit of either A or B when the service price is too high or too low. A win–win result is generated only when customer value is high enough

Table 22.1 Thresholds in section "Comparison and Discussion"

Symbol	Terms	Descriptions
V_1	$\phi S + \frac{3}{2}\beta + \frac{1}{2}c\phi^2$	$D \leq 1$
V_2	$\phi S + 2\beta + 2c\phi^2$	$D_A + D_B = 1$
V_3	$\phi S + \sqrt{2\beta^2 + 2\beta\phi S + 2\beta c\phi^2 + 2c\phi^3 S}$	$\Pi_A^1 = \Pi_A^2$
V_4	$\phi S + \beta + c\phi^2 + \frac{\beta^2}{S\phi} + \frac{\beta c\phi}{S}$	$\Pi_B^1 = \Pi_B^2$
V_5	$\sqrt{4\beta^2 + 4\beta\phi S + \phi^2 S^2 + 4\beta c\phi^2 + 4c\phi^3 S}$	$\Pi^1 = \Pi^2$
V_6	$\phi S + 4\beta + 8c\phi^2 + \frac{4c^2\phi^4 - \sqrt{6\beta^4 + 40\beta^3 c\phi^2 + 78\beta^2 c^2\phi^4 + 60\beta c^3\phi^6 + 16c^4\phi^8}}{\beta}$	$CS^1 = CS^2$

and service price is intermediate, implying a market with sufficient demand and reasonable service price.

Things are quite different for low V(i.e., $V < V_5$). Although the tendency for providers A and B to benefit from the bundle ban policy stays the same, i.e., A benefits when S is small while B benefits when S is large, A requires a smaller S while B requires a larger S to benefit from the bundle ban policy when V is low. The main reason for this intuition is the aggregate profit of A and B is smaller compared with that in the bundling case. As the only decision-maker in Scenario 2, A maximizes the profit itself ignoring the profit of the service market. Hence, he has no incentive to reduce the product price even if this may enlarge the market demand and help B to gain a higher profit. As a result, the aggregate profit is constrained by A's "selfish" strategy. Therefore, the bundle ban policy can hurt both providers in a market with low demand and intermediate service prices (Fig. 22.1).

From the perspective of consumer surplus, we have the following lemma.

Lemma 2 $CS^1 < CS^2$ *if and only if* $c\phi^2 < \frac{\beta}{5+4\sqrt{2}}$ *and* $V_1 < V < V_6$.

Lemma 2 indicates that in most cases, customers take more benefit when bundling is allowed and competition exists between two providers. The customer surplus is higher in Scenario 2 only when customer value and service congestion cost are both small. The reason behind this is that as the customer value goes up, the product price in Scenario 1 remains the same, giving more benefit to customers. However, the product price in Scenario 2 will increase as the customer value increase because of the monopoly. As a result, provider A takes part of the welfare and the customer surplus has less increment compared with that in Scenario 1. In terms of the congestion, a small coefficient suggests relatively more cost is wasted on transportation, which cut down the customer surplus in Scenario 1.

Combining the comparison above, we can identify that the bundle ban policy exerts a different impact on providers' profit and consumer surplus. When customer value is high, the bundle ban policy tends to benefit the provider and when customer value is low, the bundle ban policy can benefit the customer in some cases. Specifically, we find the following proposition.

Proposition 3 $\Pi_A^1 > \Pi_A^2, \Pi_B^1 > \Pi_B^2, CS^1 < CS^2$ *if and only if* $c\phi^2 < \frac{\beta}{5+4\sqrt{2}}$ *and* $V_1 < V < \min\{V_3, V_4, V_6\}$;

Proposition 3 shows that when customer value and congestion cost are both small, the aggregate profit in Scenario 2 is always smaller while the customer can have more surplus. The case is represented as the shadowed area in Fig. 22.2b. This indicates when customers care more about the service quality, the government can apply the "bundle ban" policy to redistribute social welfare by cutting down the profit of providers and increasing the consumer surplus.

In our basic model, we assume a congestion cost will occur when the company processes the service request, which is closer to reality. Next, we will analyze the equilibrium result when $c = 0$, corresponding to the condition when the service capacity is much larger than the demand or the congestion cost of waiting for the service is zero.

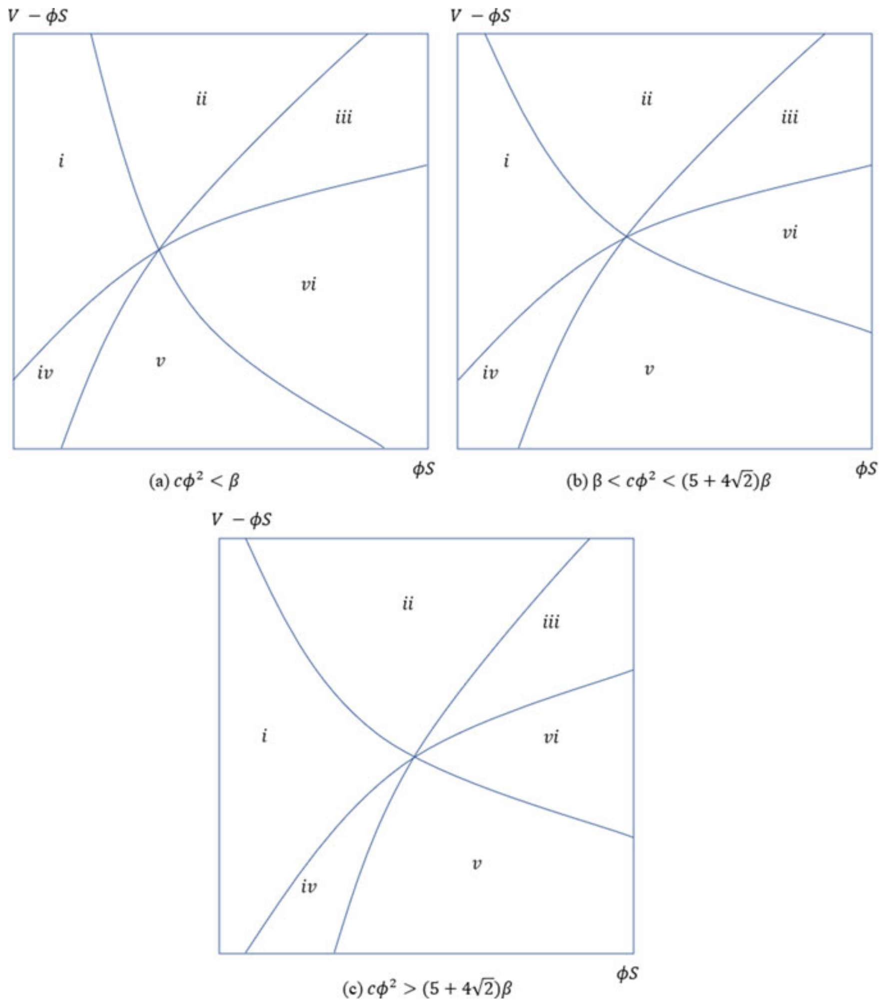

Fig. 22.1 Comparison of provider profits under different conditions

Proposition 4 The aggregate profit is always higher under the bundling strategy when there is no congestion cost.

This result may be counter-intuitive. The profit in Scenario 2 seems to increase at first sight while that in Scenario 1 remains the same when the congestion cost decrease to zero. However, remember the customer value V is also restricted to c, i.e., the V will become smaller when c decrease. As a result, the aggregate profit in Scenario 2 is positively correlated to c. A possible explanation can be that a company tends to lower the price when facing encroachment in a competitive market. This will attract more customers to purchase the product and may lead to a higher profit. However, the demand for the service will also increase and consequently generate

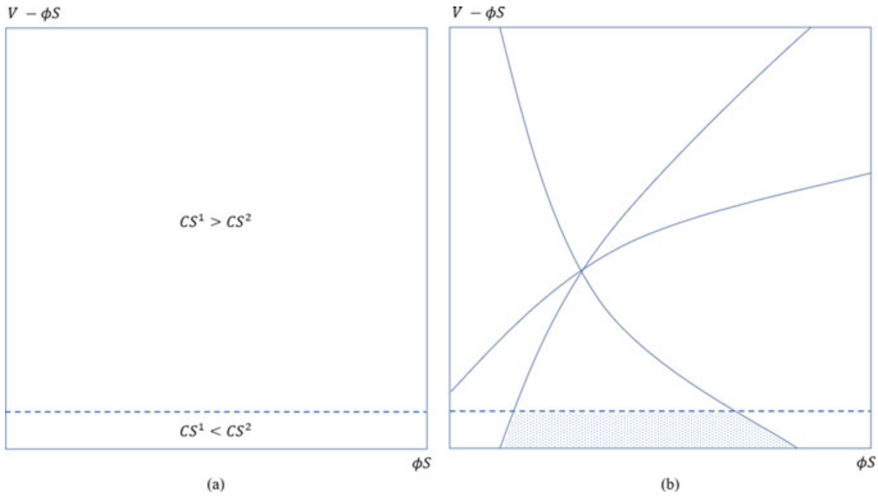

Fig. 22.2 Comparison of consumer surplus

a higher congestion cost. The bundle-ban policy can help providers to gain higher profit because of less congestion loss. Whereas when congestion cost is equal to zero, these cases disappear. The analysis in this section also indicates that the assumption of congestion cost is fundamental in our model and cannot be ignored (Fig. 22.3).

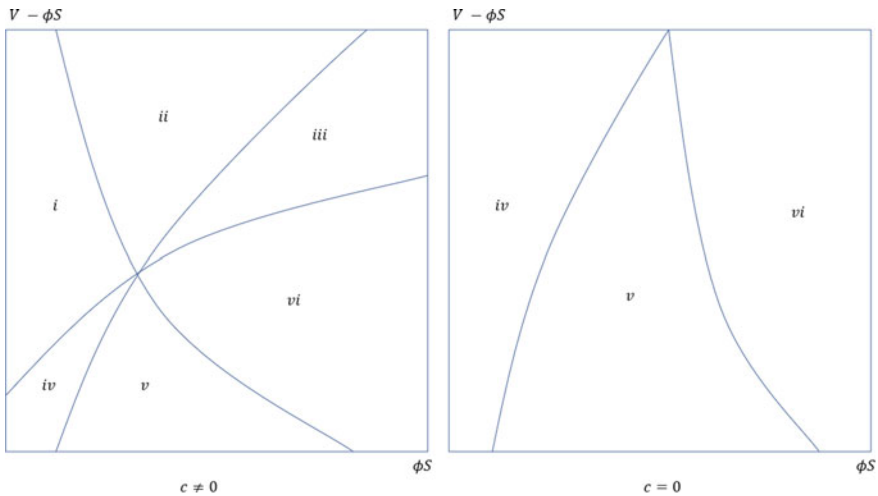

Fig. 22.3 Comparison under different congestion coefficients

Conclusion

Customers' demand for both products and services is a regular occurrence in many cases. The purpose of this research is to investigate the impact of products and services bundling in a competitive horizontal market. We compare the profit and consumer surplus under two scenarios where providers use "completely compete" and "no bundle" strategies respectively. Our findings reveal that under a bundle ban policy, increased customer value and congestion costs benefit providers, whereas service pricing has a significant impact on profit allocation between products and services providers. The low customer value and congestion cost, on the other hand, may benefit customers to some extent.

The above findings provide guidelines for providers to be more competitive by applying proper strategy with regard to different market policies and customer preferences among products and services. We also generate managerial insights which help policy-makers to decide whether products and services bundling should be allowed in such a competitive environment. In particular, products and services bundling achieves better social welfare generally while the separation may redistribute the social welfare under certain conditions.

Our research also has certain limitations. For instance, we investigate the basic horizontal competition model, and more complicated cases, such as corporations between providers, are not considered. In terms of parameters, we assume only the product price as endogenous while the relaxation of the assumption is not discussed. Further research might focus on these topics to analyze the bundling of products and services.

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