Sharing the Wealth: When Should Firms Treat Customers as Partners?

Eric T. Anderson
Graduate School of Business, University of Chicago, 1101 E. 58th Street, Chicago, Illinois 60637
eric.anderson@gsb.uchicago.edu

Marketers often stress the importance of treating customers as partners. A fundamental premise of this perspective is that all parties can be weakly better off if they work together to increase joint surplus and reach Pareto-efficient agreements. For marketing managers, this implies organizing marketing activities in a manner that maximizes total surplus. This logic is theoretically sound when agreements between partners are limitless and costless. In most consumer marketing contexts (business-to-consumer), this is typically not true. The question I ask is should one still expect firms to partner with consumers and reach Pareto-efficient agreements? In this paper, I use the example of a firm's choice of product configuration to demonstrate two effects. First, I show that a firm may configure a product in a manner that reduces total surplus but increases firm profits. Second, one might conjecture that increased competition would eliminate this effect, but I show that in a duopoly firm profits may be increasing in the cost of product completion. This second result suggests that firms may prefer to remain inefficient and/or stifle innovations. Both results violate a fundamental premise of partnering—that firms and consumers should work together to increase total surplus and reach Pareto-efficient agreements. The model illustrates that Pareto-efficient agreements are less likely to occur if negotiation with individual partners is infeasible or costly, such as in business-to-consumer contexts. Consumer marketers in one-to-many marketing environments should be wary of treating customers as partners because Pareto-efficient agreements may not be optimal for their firm.

(*Partnering; Customer Relationship Management; Efficiency; Contracting; Pareto-Efficiency; Coase Theorem*)

1. Introduction

Marketers often think of customers as partners. In addition to its managerial appeal, treating customers as partners has strong grounding in theory (Coase 1960, Wernerfelt 1994). A fundamental premise of this perspective is that firms and customers should work together to increase their joint payoff. From a practical perspective, this implies that firms should organize their marketing activities in a manner that is mutually beneficial. For example, a firm selling gas grills must decide who should assemble the grill—the firm or the consumer. Theory offers a clear prediction on who should perform this activity.[1] The low-cost (more efficient) partner should perform the task because this increases total surplus. This general principle applies to all aspects of the transaction, including product design, delivery, service, inventory, ordering, and maintenance.

Owens and Minor, Inc. (O & M), a distributor of medical supplies in the health care industry, offers an example of this partnership perspective in practice. As one O & M executive states:

> Our relationship [with our customers] has changed from adversarial to close partnership with both parties working together to identify, reduce, and eliminate non-value adding activities. When customers recognize this, they are no longer interested in negotiating a lower fee. They now work with us … (Brem 2000, p. 3).

[1] Anyone who has spent several hours assembling a 500-piece grill knows who should be performing this task!

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Managers at All Fasteners, Inc. report a similar experience after work with a customer consolidated multiple orders to reduce the customer's costs. Jim Ruetz, All Fasteners' president, commented: "Customers know that we are looking out for their welfare in a proactive nature. The best solution is always win–win" (Fretty 2001). The success of firms like O & M and All Fasteners forces one to ask whether all firms should treat customers as partners. If not, when and why will these partnerships break down and opportunistic behavior set in?

In this paper, I show when and why firms should not treat customers as partners. In the popular press, agreements that leave both parties better off are often referred to as win–win, and this is a fundamental premise of partnering (Rosenbloom 1999). Because a necessary condition for a win–win outcome is that total surplus increases, I assume that if a firm reduces total surplus it is not treating its customers as a partner. In economics, agreements that improve all parties' well-being are referred to as *Pareto efficient*. To avoid any confusion between "treating a customer as a partner" and the term "partnership" as a form of governance/relationship, I will use the term *Pareto-efficient* agreements throughout the paper. A firm that does not reach Pareto-efficient agreements is not treating its customers as a partner.

To illustrate my arguments, I allow firms to select the degree to which they complete a product for a customer. A firm may offer a *fully complete* product and leave no additional work for the customer. Alternatively, the firm may offer a *partially complete* product and leave a portion of work for the customer. Importantly, I allow the firm and customers to differ in their cost of product completion and then consider the type of product a firm should offer. Should the firm rely on customers to complete part of the product? Or, should the firm offer a fully complete product? Economic theory offers two clear predictions in this regard. First, firms should offer a fully complete product if they have lower completion costs than consumers, as this is the Pareto-efficient outcome. Second, both partners should (weakly) prefer lower completion costs for the firm, particularly if these improvements require no investment. Both of these predictions follow from the rationale that increasing total surplus must make both parties (weakly) better off.

In this paper, I show that even if a firm's completion cost is strictly greater than *every* consumer's completion cost the firm may still decide to offer a fully complete product. Further, I show that for strategic reasons competing firms may prefer to remain inefficient at product completion—even if it was costless to lower their product completion costs. Both of these results violate the presumption that firms and customers work together to increase joint payoffs and reach Pareto-efficient agreements.

Why may firms fail to reach Pareto-efficient agreements? The key assumption in the model is that firms cannot negotiate with each customer. Instead, firms quote a price and state whether the product is partially or fully complete. This assumption fits well with most business-to-consumer markets but may not fit in business-to-business markets where negotiation with each customer is possible. Indeed, one of the main contributions of this paper is to demonstrate that a firm's ability to customize offers at low cost affects whether it organizes its marketing functions in a Pareto-efficient manner. The analysis illustrates a key trade-off that firms face when one-to-one negotiation is not feasible. Consistent with economic theory, firms can increase the total surplus available by organizing activities efficiently. That is, the low-cost partner should complete the task. However, when organizing these activities, firms also consider the percent of total surplus captured. I show that firm profits may increase if they organize activities in a manner that *reduces* the total surplus but enables the firm to capture a *greater* percentage of the total surplus. Notice that contrary to what one might expect, competition may not necessarily eliminate this trade-off. If expanding total surplus also sharpens price competition, perhaps by increasing product homogeneity, then the percentage surplus of competing firms may decrease. Thus, competing firms also need to weigh the increase in total surplus against a possible decrease in the percentage surplus.

The intuition of trading off total surplus and the percent of surplus captured has been considered in models where strategic reaction plays a central role. A well-known example is the study of double marginalization in the channels literature (Jeuland and Shugan 1983, Moorthy 1987). In other channels work, Shaffer and Zettelmeyer (2000) show that manufacturers may strategically change consumer valuations in a manner that decreases total channel surplus if this increases manufacturer profits. In a model of consumer search, Wernerfelt (1996) shows that firms may not always reveal information to consumers. In each of these models, the decision to reduce total surplus is influenced by the strategic reaction of another player. For example, double marginalization is driven by the retailer's strategic reaction to wholesale price. In contrast, I strip away these strategic effects and show that the trade-off of total surplus and percent surplus still exists. The first result I present shows that a monopolist may want to decrease total surplus if this increases the price elasticity and enables the firm to capture more of the surplus. One might conjecture that increased elasticity is detrimental in a competitive setting and might mitigate this effect. Surprisingly, however, I show that this result survives in a competitive setting. The additional intuition from the competitive model is that inefficiency may play a strategic role by deterring competitive deviations.

These results do not contradict those of Coase (1960), but rather force one to think more carefully about the nature of contracts. Contracts have two general properties: terms and transfers. Terms specify the organization of tasks, control, decision rights, etc. and transfers specify monetary and nonmonetary transfers. The Coase theorem assumes that there is limitless, costless contracting. Under these conditions, the organization of tasks (the terms) can be thought of independently from how surplus is allocated (the transfers). Terms should be specified that maximize the available surplus; transfers then determine each partner's payoff. In most consumer marketing contexts, contracting is limited and costly. When this is the case, the terms and transfers need to be considered jointly.

To illustrate this, consider the previous example of a gas grill retailer who must decide whether to include assembly in the price (fully complete) or require consumers to assemble grills on their own (partially complete). There is a clear dependency between the terms (firm or consumer assembles grill) and the transfers (price includes or excludes assembly). Importantly, transfers may vary in their efficiency at capturing profits for the firm depending on how the terms are chosen. That is, the grill retailer's percent of surplus may vary depending on whether assembly is included or excluded. This dependency between terms and the percent transferred creates a trade-off. A retailer may choose to have consumers assemble the grill even if the retailer could perform this activity at lower cost if the percent of surplus captured by the retailer increases.

This dependency also results in a second effect—firms may not want to become more efficient. In Coase's world of costless contracting, the only implication of becoming more efficient is to increase the total surplus. In my model, firms must also consider how an increase in efficiency affects the allocation of tasks and the equilibrium payoffs. In a competitive setting (duopoly), I consider an equilibrium where two firms select the degree of product completion. Interestingly, if either firm lowers its product completion costs, then both firms' profits decrease. Hence, firms may prefer to stifle innovation, which violates the premise of increasing total surplus (i.e., treating customers as partners).

My analysis is related to Zettelmeyer's (2000) analysis of search costs. Zettelmeyer considers an asymmetric duopoly where one firm may prefer to create search costs for its consumers even if it were costless to eliminate them. The intuition is that by introducing these costs, the firm creates product differentiation, softens price competition, and increases profits. Thus, a firm may actually want to create inefficiency. My results differ from Zettelmeyer's in two important respects. First, Zettelmeyer looks at the cost of performing a task, while I address the question of who should perform a task—the consumer or the firm. Second, in my model I show how the relative costs of performing a task are central to sustaining a competitive equilibrium.

The question of which tasks a firm should perform also has ties to the bundling literature originally considered by Adams and Yellen (1976) and more recently studied by Bakos and Brynjolfsson (1999). In a broad sense, the choice of product configuration is a question of which bundle of products and services to offer. A common assumption in bundling models is that demand for the overall bundle is more elastic than demand for individual components that comprise the bundle. When product demand is more elastic the firm captures more surplus, and this is a common explanation for why bundling is profitable. My model has a similar property, as I assume the demand for the fully complete product (bundle) is more elastic than the partially complete product. However, my model differs in several respects. In a typical bundling model with two items, A and B, the firm might offer a pure bundle or pure components (Item A and Item B individually).[2] In my model, the fully complete product is a pure bundle, but the partially complete product is not analogous to a pure component strategy. First, I assume the value of a partially complete product is zero if it is not completed, and therefore selling the individual components as a standalone product is not a feasible strategy.[3] Second, if the firm sells a partially complete product, the consumer rather than the firm must incur the cost of product completion. Even when the firm does not incur product completion costs they still affect the price of a partially complete product. These assumptions allow me to address the question of whether product completion should reside inside or outside the firm rather than the issue of price discrimination, which is the focus of many bundling models.

Previous research in marketing has applied transaction cost analysis (TCA) to study how firms organize marketing activities. A recent paper by Carson et al. (1999) outlines three properties that must exist for partners to reach efficient agreements: (1) partners must be able to specify the set of tasks to be implemented, (2) the organization of these tasks must increase joint payoff, and (3) firms must be compensated for implementing the tasks. Similarly, Ghosh and John (1999) extend TCA to understand cooperative marketing relationships and how partners create and claim value. Both of these papers offer frameworks that relate transaction costs and other factors to observed marketing activities. Anderson (1988) is an example of one of the first empirical applications of TCA. She examined how firms organize sales force activities and shows that transaction costs serve as a determinant of opportunism. Both the theoretical and empirical TCA literature seeks to understand how transaction costs affect marketing institutions. One prediction from the TCA framework is that a task should reside outside the firm if a partner can perform the task at lower cost. My model qualifies this prediction and demonstrates that it may not hold if firms cannot negotiate with customers at low cost. It also suggests that empirical studies that use the TCA framework may want to include a measure of a firm's ability and cost to negotiate individual contracts in their analysis.

This paper has two main contributions. First, if marketers are to follow the wisdom of seeking Pareto-efficient agreements (i.e., treating customers as partners), it is important to understand when and why this logic is sound. In particular, when a single firm sells to many consumers, it may be entirely unreasonable to negotiate separate agreements with each consumer. Further, even when the firm can negotiate with individual customers, contracting costs may limit negotiation and force the firm to consider a single price. In either context, one may not observe firms reaching Pareto-efficient agreements with customers. For marketing managers, this suggests that increasing total surplus may not be an appropriate objective in one-to-many marketing contexts. However, in one-to-one marketing contexts, this may be entirely appropriate. Second, the model shows that relative efficiency may play an important strategic role for firms. While somewhat counterintuitive, firms may actually prefer to remain relatively inefficient. Industries may prefer to delay innovations that decrease costs (and increase surplus) if the innovations also lead to increased competition.

In the model, I consider two retail establishments selling to many consumers, who one can think of as individuals or business partners. In the first model I consider a monopoly owner (one firm owns two retail establishments) and in the second model I assume independent ownership (duopoly). For ease of exposition, I focus on the question of whether the firm

[2] A mixed bundle may also be offered, and is similar to offering a menu of a partially complete product and a fully complete product.

[3] In other words, if a consumer bought a partially complete product and did not incur the completion costs, the product has zero value.

should offer a fully complete or partially complete product. Note that this formulation is quite general and encompasses many common business-to-business and business-to-consumer selling situations. For example, in the software industry a seller may offer a turnkey solution that is fully complete. Alternatively, the firm may offer a partially complete product and the customer could "complete" the product in-house or outsource this to a third-party vendor. In a business-to-consumer context, a clothing retailer may include tailoring in the price (fully complete) or ask the customer to use his or her own tailor (partially complete). While the model is illustrated using the degree of product completion, the results apply to any allocation of tasks between firms and consumers, such as assembly, ordering, inventory, service, etc.

The paper is organized as follows. In §2, I consider a simple example to illustrate some of the intuition for the model. In §3, I present the model and results. I first present the monopoly model, which illustrates why firms may not reach Pareto-efficient agreements (i.e., treat customers as partners). I then consider a competitive model that illustrates the strategic role of efficiency. In the previous model I exogenously assume that firms cannot negotiate with individual consumers, and in §4 I endogenize this assumption. I consider a model where individual negotiation is feasible, but firms offer the same price to all consumers due to limited information. I conclude with a discussion.

2. Example

To illustrate some of the intuition for the model, consider the following example. A single firm sells a single product to two customers—X and Y. The firm must decide whether to offer a partially complete or fully complete product, analogous to the earlier example of a software vendor or a retail clothier. The firm's production cost of a partially complete product is zero, and either the firm or the consumer must incur additional costs to complete the product. If the product is not completed it has no value. Both customers value a fully complete product at $100 but incur additional costs to finish the product. I assume Customer X incurs a cost of $10 and Customer Y incurs a cost of $20 to transform a partially complete product into a fully complete product (Table 1). Thus, the willingness to pay (WTP) of each customer depends on whether the firm offers a partially or fully complete product.

Table 1 **Willingness to Pay for Each Product Type**

Segment	Fully complete product	Partially complete product
X	$100	$90
Y	$100	$80

For the moment, assume that the firm's product completion costs are identical to the consumers—$10 and $20, respectively. In other words, the firm must spend an additional $10 ($20) to turn a partially complete product into a fully complete product for Customer X (Y).

Given these consumer preferences, firm costs, and product options, the firm must select a price and product configuration. Suppose the firm chooses a fully complete product. Since each customer's WTP is $100, the optimal price of a fully complete product is $100. The firm incurs $30 in completion costs and earns a net profit of $170. Now suppose that the firm decides to offer a partially complete product. Because customers incur completion costs, the optimal price is $80 and profits are $160. Why does the firm strictly prefer a fully complete product? In both cases, there is a total of $170 of surplus available for the firm. However, the elasticity of the demand curve differs for a fully complete and partially complete product. If the product is fully complete, demand is perfectly elastic and the firm can extract 100% of the surplus. However, the demand curve of a partially complete product is more inelastic, and the firm only captures 94% of the surplus. The $10 difference in profits between the two scenarios is simply the surplus that Customer X captures.

Now suppose that the firm's product completion cost is $1 greater per customer—$11 for X and $21 for Y. The total surplus available for the fully complete product is $168 and for the partially complete product the total surplus is still $170. If the firm desires a Pareto-efficient outcome (i.e., treats its customers as partners), then the firm should offer a partially complete product and allow customers to finish the product. But a fully complete product captures more

(100%) of the available surplus, while a partially complete product only captures 94% of the surplus. Since $\$168 * 100\%$ is greater than $\$170 * 94\% = \$160$, the firm will offer a fully complete product. If the firm could costlessly negotiate with each customer one-to-one, then the firm would reach a Pareto-efficient outcome. The firm could negotiate prices with each customer, allow customers to arrange for product completion, and weakly increase each partner's payoff.

To illustrate the competitive issues, consider the same customers, but now there are two firms. I assume that customers value Firm B's fully complete product at \$100, but have different completion costs for Firm B's partially complete product. Customer Y has lower costs to finish Firm B's product (\$10), while Customer X incurs greater completion costs (\$20). One interpretation of these assumptions is that Firms A and B offer slightly different partially complete products that vary in customer "fit." For example, a customer may place the same value on two different blue suits (i.e., fully complete), but the amount of tailoring required to finish the suits may vary. Finally, to simplify the example I assume the cost to each firm of finishing a partially complete product is identical to the consumer's cost, as shown in Table 2.

Now consider the case where each firm offers a fully complete product. Since customers do not incur completion costs, they buy from the firm with the lowest price. If prices are equal, I assume customers buy from the firm with the best "fit" (i.e., low cost of completion). If both firms charge exactly the same price, what is the highest price they can offer? At the monopoly price of \$100, each firm earns \$90. But this is not sustainable because either firm can offer \$99.99, sell to both customers, and earn a profit of \$169.98. In fact, one can show that the highest sustainable price is \$20 for both firms. It is not a coincidence that this price equals the firms' cost of product completion of the customer not served (see Table 2). This product completion cost is exactly what affects either firm's incentive to undercut and sell to the entire market. If Firm B undercuts the price to \$19.99, it sells two units but loses money on Customer Y because the completion cost exceeds the price. Even though Firm A never sells to Customer Y, an increase in completion costs for customers not served will benefit both firms. As an example, if completion costs increase from \$20 to \$30 for customers not served, both firms can raise fully complete product prices to \$30. Even though neither firm incurs this cost in equilibrium, both firms benefit by an increase in product completion costs.

Table 2 Customer Valuation and Firm Completion Costs

		Firm's cost of product completion	
Customer	Product value	Firm A	Firm B
X	\$100	\$10	\$20
Y	\$100	\$20	\$10

3. Model

In this section I formalize the previous examples. I consider a Hotelling model with two retail outlets, A and B, located at either end of the unit line (A at $x = 0$, B at $x = 1$). Each firm can sell either a fully complete product or a partially complete product, and without loss of generality I normalize the firm's production cost of a partially complete product to zero. All consumers value a fully complete product at V, but the value of a partially complete product is reduced by the consumer's completion cost. I assume the cost of product completion is proportional to the distance between a consumer and firm j, x_j, and consumers are uniformly distributed on the unit line. If the consumer finishes the product, the consumer's completion cost is t per unit distance and the net surplus is $V - \text{price} - \text{distance} * t$. If the firm finishes the product (i.e., offers a fully complete product), I assume the firm's completion costs are βt per unit distance where $\beta \in [0, +\infty]$. Comparing β to 1 determines whether firms are more or less efficient than *every* consumer at product completion. When the retail outlets offer fully complete products, customers are indifferent between stores and I assume customers buy from the nearest retail outlet. The timing of the game is that each retail outlet posts a price and the product configuration (partially or fully complete), and then customers decide whether to buy.

Note that I assume that firms offer a single price and cannot negotiate with individual customers (i.e., limited contracting). This assumption fits many markets, particularly business-to-consumer markets.

Many firms choose to offer a single price, rather than negotiate, because bargaining may involve additional costs. From the consumer's perspective, bargaining may create disutility or "hassle costs." These hassle costs may be due to the actual negotiation process or due to the perception of an unfair outcome. From the firm's perspective, bargaining requires costly investments in either a sales force or information technology (e.g., online negotiation). Firms may also incur additional costs in delay or potentially lost sales. In sum, when bargaining costs are significant firms may not negotiate—even if negotiation is a feasible strategy. In §4, I endogenize this assumption.

The model assumptions are consistent with many selling situations, such as the example of a clothing retailer offered in the introduction. In these settings, one might expect firms to offer a single price and customers to vary in their demand for customization. The assumption that the firm and consumer's completion costs are correlated is also natural in these selling situations. If a consumer demands few product alterations, both the firm and consumer will have low product completion costs. Similarly, a consumer that demands more customization will either incur these costs herself or impose these costs on the firm.

Existing theory offers straw-man predictions for the model. First, one expects that, holding demand constant, a firm should prefer to reduce transaction costs. This implies that when $\beta > 1$ the firm should offer a partially complete product (i.e., outsource) and when $\beta < 1$ the firm should offer a fully complete product (i.e., perform the task in-house). Second, if a firm fails to minimize transaction costs, a "standard" response is that competition will mitigate this effect (Milgrom and Roberts 1992 p. 34). Contrary predictions from the model should be somewhat surprising and should highlight conditions under which one fails to achieve a Pareto-efficient outcome.

Before proceeding, two technical points are worth mentioning. First, while all of the heterogeneity in the model is due to product completion costs, adding heterogeneity on other dimensions, such as product values, does not change the main results. The important assumption is that demand is more elastic for a fully complete product, and the assumption of a perfectly elastic demand curve simplifies the analysis.[4] Second, I do not allow one firm to offer both a partially complete and a fully complete product. This differs from casual empiricism, where one may observe firms offering a menu of choices. In the conclusion (§5), I explain why such a model is interesting but offers few additional insights with respect to this paper.

Table 3 Monopoly Prices and Profits

Product choice	Prices	Profits
Partially complete product	$V - t/2$	$V - t/2$
Fully complete product	V	$V - \beta t/4$

3.1. Monopoly Case

Assume that a parent firm owns both retail outlets. If the firms offer a fully complete product, then each customer buys, provided $p \leq V$. Thus, the maximum fully complete price is V. Because the firm sells to the entire market, the total cost of product completion for the firm is $(\beta t/4)$ and total revenues are V; profits from offering a fully complete product are $V - (\beta t/4)$. If the firm offers a partially complete product, customer utility at Retail Outlet A is $V - p_A - x_A * t$, where x_{A} is the distance to Store A. I propose a symmetric equilibrium with $p_{\mathrm{A}} = p_{\mathrm{B}}$ and prove this is an equilibrium by construction. The maximum price at which all customers purchase is $V - t/2$. At this price, demand at each retail outlet is $\frac{1}{2}$, total demand is 1, and profits equal $V - t/2$. These are summarized in Table 3. Charging a higher price and selling to fewer customers is not profitable provided $V > t$.[5]

I now compare profits depending on whether the firm offers a partially or fully complete product. The firm prefers to offer a fully complete product if $V - \beta t/4 > V - t/2$. This condition holds for $\beta < 2$, or the firm's product completion cost is no more than

[4] Note that the firm offers a single price for either a fully complete product or a partially complete product. Thus, price discrimination does not play a role in the model. I thank an anonymous reviewer for bringing this to my attention.

[5] If a retail outlet raises the price and sells to fewer than half the customers, demand is $x = (V - p)/t$. The optimal price is $p = V/2$ and $x(p) = x(V/2) = V/(2t)$. But, $x(p) > \frac{1}{2}$ if $V/(2t) > \frac{1}{2}$ or $V > t$.

twice a consumer's. This leads to the following proposition:

Proposition 1: Inefficient Choice of Product Configuration in a Monopoly. *Even if a monopolist incurs greater product completion costs than every consumer, a monopolist will offer a fully complete product provided the firm's completion costs are no more than twice consumers'* ($\beta < 2$).

Proof. By construction.

For $\beta \in [1, 2]$, the firm is more inefficient than every consumer and offering a fully complete product is not a Pareto-efficient agreement, which is a direct violation of the wisdom of firms treating customers as partners. In the absence of competition, the firm prefers to incur the cost of product completion because demand is more elastic (demand becomes perfectly elastic) and more of the potential surplus is captured. Notice that consumers are clearly worse off when the firm offers a fully complete product rather than a partially complete product. When a partially complete product is offered, all but the marginal consumer extracts some surplus, while when a fully complete product is offered consumers enjoy no surplus.

This simple model illustrates an important intuition. When contracts are limited, there may be a strong dependency between how tasks are organized between partners and the amount of surplus each partner captures. When this dependency exists, opportunistic behavior dominates, and firms and consumers may no longer reach Pareto-efficient agreements.

3.2. Duopoly Case

I now turn to the situation of a duopoly. The monopoly case illustrates that firms may not reach Pareto-efficient agreements (i.e., treat customers as partners), and one might expect that competition eliminates this result. However, I show that an analogous result holds in a duopoly and demonstrates another anomaly—firms may not want to lower their product completion costs. In the duopoly model, I assume that firms simultaneously determine their product configuration (i.e., partially or fully complete) and price. While I focus on a simultaneous equilibrium, the main results hold for a sequential equilibrium that I briefly discuss.

Simultaneous Game. In the simultaneous game, there are two equilibria in which both firms choose the same product configuration. I label these the *partially complete* equilibrium and the *fully complete* equilibrium. For each I derive equilibrium prices and profits and then consider deviating strategies, providing the equilibrium conditions. In the appendix, I demonstrate that a pure strategy asymmetric equilibrium does not exist in this game.

Partially Complete Equilibrium. Consider an equilibrium where both firms offer a partially complete product. Demand at Firm A is $x_{\mathrm{A}} = (p_{\mathrm{B}} - p_{\mathrm{A}})/(2t) + \frac{1}{2}$. Since customers pay for product completion, profits are $p_{\mathrm{A}} x_{\mathrm{A}}$. Given this, one can show that the optimal prices are $p_{\mathrm{A}} = p_{\mathrm{B}} = t$ and profits are $\pi_{\mathrm{A}} = \pi_{\mathrm{B}} = t/2$ (see appendix for details).

If Firm A offers a partially complete product at price $p_{\mathrm{A}} = t$, does Firm B want to defect and offer a fully complete product? Profits to Firm B when offering a fully complete product are $(1 - x_{\mathrm{A}})p_{\mathrm{B}} - (1 - x_{\mathrm{A}})^2 \beta t/2$. The term $(1 - x_{\mathrm{A}})p_{\mathrm{B}}$ is the total revenue and the term $(1 - x_{\mathrm{A}})^2 \beta t/2$ is the total cost of Firm B paying for product completion.[6] Because customers don't incur product completion costs, a customer compares $V - p_{\mathrm{B}}$ to $V - p_{\mathrm{A}} - x_{\mathrm{A}} t$, which yields demand at Firm A of $x_{\mathrm{A}} = (p_{\mathrm{B}} - p_{\mathrm{A}})/t$. The equilibrium price at A is $t/2$, hence Firm B's demand is $x_{\mathrm{B}} = (1 - x_{\mathrm{A}}) = 2 - p_{\mathrm{B}}/t$. As shown in the appendix, this yields an optimal price of $p_{\mathrm{B}} = (2t)(1+\beta)/(2+\beta)$ and demand $x_{\mathrm{B}} = 2/(2+\beta)$. Profits from a defection to a fully complete product configuration are $\pi_{\mathrm{B}} = (2t)/(2+\beta)$. One can now compare equilibrium profits ($t/2$) to the defecting profits and show that defection is not profitable provided $\beta \geq 2$. Note that this equilibrium is Pareto efficient because firms allocate product completion to the more efficient party.

[6] To see this intuitively, Firm B sells to a total of $(1 - x_{\mathrm{A}})$ customers. The average customer is located at $(1 - x_{\mathrm{A}})/2$ and the firm's product completion costs for the average customer are $(1 - x_{\mathrm{A}})\beta t/2$. Since the distribution of costs is uniform, the firms costs are total sales $*$ average product completion cost $= (1 - x_{\mathrm{A}}) * (1 - x_{\mathrm{A}})\beta t/2$.

Fully Complete Equilibrium. In the fully complete equilibrium, both firms charge the same price, p, for a fully complete product and I assume consumers purchase from the firm with the best "fit."[7] Thus, firms divide the market evenly and sell to half the customers, the cost of which is $(\beta t/8)$. In equilibrium, profits are $p/2-\beta t/8$. To determine p, I consider the maximum price firms can set without triggering a defection to $p-\varepsilon$. If a firm defects, they sell to the entire market at a cost of $\beta t/2$. Hence, the maximum price is given by $p/2-\beta t/8 \geq p-\beta t/2$, which implies $3\beta t/4 \geq p$. At $p=3\beta t/4$, profits are $\pi_A=\pi_B=\beta t/4$. Note that while prices are increasing in β, this is not without limit because the maximum price is $p=V$.

Consider defections from the fully complete equilibrium where one firm deviates and offers a partially complete product. If Firm A switches to a partially complete product, customers compare $V-p_A-x_A t$ to $V-p_B$, and demand at Firm A is $x_A=(p_B-p_A)/t$. Since customers pay for product completion, Firm A's profits are $\pi_A=p_A x_A$. The optimal price at A is $p_A= p_B/2=3\beta t/8$, demand is $x_A=3\beta t/8$, and profits are $\pi_A=9t\beta^2/64$. The profits from defecting $(9t\beta^2/64)$ are less than equilibrium profits $(\beta t/4)$ if $\beta \leq 16/9$. Therefore, if product completion costs become too large a defection is triggered. At $\beta=16/9$, a firm can defect and sell to $x_A=2/3$ of the market at a price of $p_A= 2t/3$. Profits are $4t/9$ from defection and this equals equilibrium profits. For $\beta \in (1, 16/9]$, firms face higher product completion costs than every consumer, but in the proposed equilibrium firms offer a fully complete rather than partially complete product.

Because the equilibrium conditions on β do not intersect, these equilibria are unique. If the firm's product completion costs are sufficiently small (i.e., $\beta<16/9$), then the unique equilibrium is for both firms to offer fully complete products. If the firm's product completion costs are sufficiently large (i.e., $\beta>2$), then the unique equilibrium is for both firms to offer partially complete products. The equilibrium prices and profits are summarized in Table 4. The caveat that prices cannot exceed V follows from customer's maximum willingness to pay (participation constraint).

[7] If one interprets x_j as "fit," customers purchase from Firm A if $x_A<x_B$.

Table 4 Firm Prices, Profits, and Equilibrium Conditions for Duopoly

Product choice	Prices	Profits	Equilibrium conditions
Partially complete	t	$t/2$	$\beta>2$
Fully complete	$\min(3\beta t/4, V)$	$\min(\beta t/4, V/2-\beta t/8)$	$\beta<16/9$

Note. In the fully complete equilibrium $3\beta t/4$ and $\beta t/4$ are the maximum equilibrium price and profit.

It is also interesting that profits are strictly greater for the simultaneous fully complete pricing equilibrium than simultaneous partially complete equilibrium when $\beta<2$. If one thinks of firms optimally selecting β, the highest payoff is given by $\beta=16/9$ and both firm's offering fully complete products.

Implications of Duopoly Model. Recall that the intuition from the monopoly case is that when a firm offers a fully complete product, demand is perfectly elastic and a greater percentage of surplus is captured. Because demand is more elastic, one might suspect that competition would mitigate this effect. However, the competitive fully complete equilibrium illustrates that this is not the case. Even under competitive pressure, firms still consider the trade-off between creating more surplus and capturing this surplus. Thus, the intuition from the monopoly model extends to the competitive framework and is summarized in the following proposition.

Proposition 2: Inefficient Choice of Product Configuration in a Duopoly. *Even if two competing firms incur greater product completion costs than every consumer, firms will offer a fully complete product provided the firm's completion costs are not too "large"* (*i.e.*, $1<\beta<16/9$).

The intuition for this result stems from two factors. First, similar to the monopoly case, firms continue to capture the rent-extracting benefits of a more elastic demand curve. Second, an increase in each firm's product completion costs (larger β) deters defections and raises price. Recall that when offering a fully complete product, the pricing equilibrium considered defections by one firm to undercut and steal the entire market. However, the cost of serving the entire market is increasing in β. Thus, as β increases defections are less profitable, which increases equilibrium prices.

An implication of this is that neither firm may have incentive to lower production costs. If *either* firm lowers product completion costs (i.e., β), both firms' prices and profits decrease. Also, if *both* firms increase their product completion costs (i.e., β), prices and profits increase. The reason for this is that a change in β has both a direct effect and a strategic effect. Holding prices constant, the direct effect is to reduce a firm's product completion costs, which increases profits. However, the strategic effect is to reduce both firm's prices to such an extent that profits decrease. Cabral and Villas-Boas (2001) refer to situations where the negative strategic effect dominates the positive direct effect as a Bertrand supertrap. Notice that this insight does not extend to the monopoly case, as only the direct effect plays a role the monopolist strictly prefers to reduce product completion costs, which increases profits.

The fact that a reduction in β for either firm reduces profits differs from a standard Hotelling model with two firms, identical product costs ($c = c_1 = c_2$), and consumer utility $V -$ distance $* t_j - p_j$. Holding competitive actions constant in this standard model, profits increase if one's own transportation cost (t_j) decreases. In other words, creating more surplus by reducing t_j is profitable. In my model, when firms offer a fully complete product, demand is more elastic. When either firm lowers its product completion cost, there is increased incentive to steal customers, which reduces prices for both firms. Reassuringly, if both firms increase product completion costs (transportation costs), then my model offers a similar prediction as the standard Hotelling result, albeit for a different reason. In the Hotelling model, increased transportation cost for both firms increases product differentiation. In my model, increased product completion cost reduces the temptation to undercut price and serve the entire market.

Sequential Game. To demonstrate that the results do not hinge on the choice of a simultaneous vs. sequential game, I also consider a two-stage game. In the first stage, firms simultaneously select whether to offer a fully complete or partially complete product. In the second stage, firms simultaneously select prices given the results of the first stage. In this game, there exist two pure strategy, symmetric, subgame perfect (SGP) equilibria. The prices and profits for these equilibria are identical to the simultaneous game (Table 4). In the appendix, I show that a pure strategy, SGP asymmetric equilibrium does not exist.

In the sequential partially complete equilibrium, one can show that for all $\beta \geq 0$ it is never profitable to defect. Thus, the decision of which product type to offer is independent of the total surplus, which implies that Pareto efficiency is not a criterion. If firms were concerned with the total surplus, customers would only complete the product when they could perform the task at lower cost. However, the results show that the partially complete equilibrium is sustainable even when each firm's cost of product completion is zero!

In the sequential partially complete equilibrium, the payoff for either firm defecting from the equilibrium is $t[(1+\beta)/(2+\beta)]^2$. As shown in the appendix, deviation is not profitable provided β is sufficiently high (i.e., $\beta \geq 2.38$). The equilibrium condition implies that the firm must be relatively inefficient at performing the task ($\beta > 1$) for the equilibrium to exist. Each firm faces higher product completion costs than *every* customer but the firm still performs this task, and this clearly violates the notion of allocating tasks to the low-cost partner.

Importantly, the sequential game results replicate the key features of the simultaneous game. Firms may offer fully complete products even if firm product completion costs exceed consumer costs. Firms may also prefer to maintain high product completion costs and may stifle innovations that reduce either firm's product completion costs. An additional result from the sequential partially complete equilibrium is that firms may shift product completion costs to consumers, even if the firm can complete the task at lower cost. In sum, the sequential game reinforces that a firm's choice of product configuration is not always Pareto efficient.

4. Bargaining with Endogenous Contracting Costs

In the previous section, I exogenously assume that firms are unable to target each individual consumer with a separate agreement (i.e., limited contracting).

Even when contracts can be tailored to individuals, firms may not negotiate due to contracting costs. These costs include hassle costs incurred by the firm or consumer from protracted negotiations as well as costs incurred due to limited information by either the firm or consumer. In this section, I allow the firm to offer separate agreements to each customer. Under full information, it is well known that the Pareto-efficient outcome is obtained, and I review these results. However, if the firm faces limited information about consumers' valuations, I show that the firm may forgo negotiation even though it is feasible. I begin this section with a brief review of bargaining literature, then present a model of bargaining with one-sided asymmetric information.

If firms are able to bargain with individual consumers under full information, no transaction costs, and unlimited transfers, then they will always design their marketing functions to maximize total surplus (i.e., Coase theorem). The Coase theorem predicts that partners will reach an efficient outcome, but it does not offer any prediction on the division of surplus. In a repeated bargaining context, both Ståhl (1972) and Rubinstein (1982) show that partners immediately reach efficient solutions and that "haggling" does not occur. An important contribution from this work is that it offers a unique prediction for the division of surplus. While bargaining has received less attention in the marketing literature, recent work by Iyer and Villas-Boas (2001) demonstrates that bargaining between a retailer and manufacturer can increase total channel efficiency. In sum, this literature shows that the ability to make one-to-one offers at no cost (i.e., unlimited, costless contracting) may lead to Pareto-efficient outcomes.

When either partner has limited information, several problems emerge: Inefficient outcomes may occur and equilibrium outcomes may not be unique. Myerson and Satterthwaite (1983) show conditions in which inefficiency always occurs in a bargaining game where neither partner is informed about the other partner's valuation. In their model, there is an opportunity for gains from trade, but lack of information prevents trade from occurring. Equilibrium uniqueness is also an issue in games with limited information due to many possible out-of-equilibrium actions as well as the possibility that agents may take actions to signal or screen information.[8]

I consider a model where a single firm can offer individual contracts and bargain with customers, but the firm is uncertain about each customer's valuation.[9] To limit signaling, I assume that the firm makes at most two offers and that the consumer may accept or reject any offer. Both consumers and the firm use a discount factor δ to deflate utility and profits in Period 2. For comparison with the monopoly model in §3, I assume the same distribution of customer valuations, product completion costs, and location of retail outlets. The timing of the game is as follows. The firm offers price p_1 in Period 1 and the consumer then accepts or rejects this offer. If the consumer rejects the offer, the firm updates its beliefs about the consumer's valuation and then offers a price p_2 in Period 2. If the second offer is rejected no further negotiation takes place.

If the firm offers a fully complete product, the firm incurs the cost of product completion and all consumers value the product at V. Thus, an offer of $p = V$ is accepted in the first round and the profits equal $V - \beta t/4$. If the firm offers a partially complete product, whether a consumer accepts or rejects an offer depends on his net valuation: V − product completion costs. I assume each retail outlet serves a group of customers with product completion costs uniformly distributed between 0 and $t/2$. Because the firm is uncertain about each customer's valuation, it may offer a high price in Period 1 and a moderate price in Period 2 and sell only to customers with sufficiently high valuations. Under this strategy, the optimal prices and expected profits for a partially complete product are:

$$p_1 = V\frac{(2-\delta)^2}{2(4-3\delta)}, p_2 = \frac{p_1}{2-\delta}$$

and

$$E[\pi] = V^2\frac{(2-\delta)^2}{2t(4-3\delta)}.$$

[8] See Rubinstein (1985), Chatterjee and Samuelson (1987), and Gul and Sonnenschein (1988) for more details on limited information in bargaining.

[9] See Gul and Sonnenschein (1988) for a general bargaining model with one-sided information.

Consumers correctly anticipate that prices in the second round are lower and reject all offers in Period 1 if their valuation is less than or equal to $2p_1/(2-\delta)$. In Period 2, consumers accept any price less than or equal to their reservation price.

An alternative strategy for the firm is to serve all customers in Period 1 at $p = V - t/2$. All customers accept this offer, as they correctly anticipate that the price will not decrease in Period 2. A sufficient condition for the firm to sell to all customers in Period 1 at $V - t/2$ is:

$$V - \frac{t}{2} > V\frac{(2-\delta)^2}{2(4-3\delta)}.$$

The above condition states that the optimal first-period price in the bargaining game is less than the price that clears the market. Recall that in the monopoly case we assumed that $V > t$ to ensure that all consumers were served. As shown in the appendix, if $V > t$, then the above inequality is always true and therefore it is optimal for all consumers to purchase in the first period at $p = V - t/2$.

Even though the firm can negotiate with each customer, the firm offers the same prices as a monopolist for both the partially complete and fully complete product. Thus, the firm faces the same trade-off when deciding whether to offer a fully complete or partially complete product. This endogenizes the earlier assumption that negotiation is not feasible and demonstrates that one-to-one marketing alone is not sufficient to guarantee Pareto-efficient outcomes. While the firm has a richer contracting space (i.e., customized offers), the firm must also consider contracting costs. When the opportunity cost of a lost sale is sufficiently great, the firm may forgo the opportunity to negotiate and offer a single market-clearing price to all customers—even though customized offers are feasible. More generally, the presence of contracting costs pushes the firm back to the same trade-off illustrated in §3. Together, the models in §3 and §4 illustrate that limited contracting (i.e., uniform price offers) and contracting costs (e.g., limited information, hassle costs) may prevent firms from reaching Pareto-efficient agreements. When firms consider the contract terms and transfers jointly, they will trade off total surplus (i.e., Pareto efficiency) with the percent surplus captured.

5. Discussion and Conclusion

Both managerial wisdom and academic theory suggest that treating customers as partners is a desirable strategy. However, theoretical grounding of this presumes that firms can costlessly negotiate with each customer and reach agreements so that both parties' payoffs increase. This is the win–win managers seek. In business-to-business settings this wisdom has merit if contracts can be customized at low cost for each individual. In many industrial marketing contexts, the role of a salesperson is to evaluate a customer's needs, match the customer with an appropriate product, and then negotiate a price. In this situation, firms should seek to generate as much total surplus when they design the product and then capture as much of this surplus in price negotiations. Thus, in many business-to-business settings we might expect firms to treat customers as partners and reach Pareto-efficient outcomes.

The experiences of Owens and Minor, Inc. and All Fasteners, Inc. are consistent with this approach. These firms negotiate both prices and product terms with each customer independently. All firms in the channel recognize that every party could be better off by increasing the total surplus. The move to category management by manufacturers such as Lever Brothers is also consistent with partnering. Mitchell (1994) writes: "The category management teams are responsible for having a vision of the category, which is not just brand driven but also looks at the category as the retailer does." Incorporating the retailer's perspective allows Lever Brothers to consider the joint manufacturer/retailer payoff in designing marketing strategies.

However, in consumer marketing contexts this type of negotiation is often not possible. Most consumer marketing transactions occur with a firm quoting a price and associated terms. If customers were partners, the firm would select terms that maximized joint surplus. However, I have shown that firms may not do this. In addition, I also show that firms may forgo opportunities to lower their costs and increase total surplus. Firms will spurn innovation that increases total surplus but reduces firm profits.

The intuition for both these results follows from a simple trade-off firms face. When individual agreements cannot be negotiated with each customer or when there are significant contracting costs, firms are concerned with the total surplus available as well as the percent of surplus captured. In the model, firms select the product configuration in a manner that maximizes profits but is not necessarily consistent with maximizing total surplus. Firms may choose to reduce total surplus when they can capture a greater percent of surplus and these results contrast with theoretical predictions where contracting is limitless and costless.

The model does not allow firms to offer a menu of prices where customers select either a partially complete or fully complete product. In this type of model, customers with low completion costs (i.e., located near either firm) purchase a partially complete product and customers with higher completion costs (i.e., towards the center of the market) purchase a fully complete product. I claim that, while interesting for other purposes, this type of model does not extend the results of this paper. Suppose a firm offers a menu and sells some units of a partially complete product and some units of a fully complete product. In my model, by construction the firm has either lower or higher product completion costs than all customers. Hence, any equilibrium where the firm sells some units of both product types reduces total surplus. More generally, suppose my model is relaxed such that some customers face higher product completion costs than the firm and some customers face lower product completion costs than the firm. For an efficient allocation of tasks, the customer indifferent between the partially complete product and the fully complete product must also be the customer with exactly the same product completion costs as the firm. While there exists an equilibrium in which the price difference between a partially complete and fully complete product is exactly the firm's product completion cost, this is clearly a knife-edge case and is therefore uninteresting.

One might also wonder how extending the model to include more vertical markets would affect these results. For example, suppose a manufacturer realized that surplus was maximized when consumers (vs. the retailer) incurred product completion costs. A manufacturer might include these terms in the retail contract but will also have to compensate the retailer for agreeing to adverse terms that lower retail profits. Unless the manufacturer is able to capture some of the increased surplus from consumers, manufacturer profits will decline. Thus, an important corollary of these results is that limited contracting at any stage of the value chain will reduce total channel surplus. This suggests that new technologies that facilitate low-cost, one-to-one negotiation with other firms or consumers could result in a more efficient allocation of tasks that increases total surplus. More personalized forms of exchange may not only affect each participant's share of the surplus, but total surplus as well.

The results of this paper are of particular importance to any manager deciding which services to offer consumers. In the model, I focus on product configuration but the results apply more broadly to any type of task. For example:

- Should firms use the Internet to shift order entry from customer service representatives to consumers?
- Who should perform assembly for toys, gas grills, vacuum cleaners, lawn furniture, etc.?
- Should the price of delivery be included or excluded from the price (i.e., delivered pricing vs. FOB pricing)?
- Should after-sales support be included in the price or should each customer pay for this separately?
- Should a firm offer digital storage of a product or should consumers be responsible for choosing their own digital storage (e.g., photos)?

If marketers follow the wisdom of partnering, then a firm should only offer a service when they are the low-cost provider. However, as I have shown, this wisdom only applies when firms can customize agreements at low cost with each customer, such as in business-to-business settings. When the scope of agreements is limited and negotiation is relatively costly, as in most business-to-consumer contexts, firms will trade off total surplus and the percent of surplus captured. As such, they may not organize their activities in a manner that generates maximal surplus. Further, the firm may not seek to reduce its costs of offering a service, as this may sharpen price competition. In sum, this paper shows that seeking Pareto-efficient agreements (i.e., treating customers as partners) only makes sense in markets where negotiation and customized agreements are possible. Innovations in information technology may eventually result in widespread personalization. However, without customized, one-to-one negotiation, marketers should question the wisdom of treating customers as partners.

Technical Appendix

Monopoly Case. Assume there are two retail locations, A and B, located at either end of a Hotelling line of length one. Assume one firm owns both retail locations.

Partially Complete Product Pricing. Customer finishes product, so the indifferent customer is given by:

$$V - p_A - x_A t = V - p_B - (1 - x_A)t,$$
$$x_A = (p_B - p_A)/(2t) + 1/2.$$

Look for a symmetric solution with $(p_B - p_A) = 0$ that serves the entire market. Thus, $V - p_A - \frac{1}{2}t = 0$ or $p_A = p_B = V - (t/2)$. Total profit for the firm equals $V - (t/2)$. I assume that $V > t$, and this precludes strategies of offering a higher price and selling to a fraction of the market.

Fully Complete Product Pricing. The firm finishes the product and because all customers value the fully complete product at V, the optimal price is $p = V$. I assume that the nearest retail outlet provides the product. Total cost of product completion is $(\beta t/4)$ and profits are $V - (\beta t/4)$.

Comparison of Fully Complete vs. Partially Complete Product.

$$\text{Profit fully complete} > \text{Profit partially complete},$$
$$V - (\beta t/4) > V - t/2, \text{ which simplifies to } \beta < 2.$$

Thus, the firm may prefer a fully complete product even if its completion costs exceed all customers' completion costs (i.e., $\beta \in [1, 2]$).

Competitive Case Simultaneous Game. Assume there are two retail locations, A and B, located at either end of a Hotelling line of length one. Assume a different firm owns each retail location. Each firm simultaneously decides on price and whether to offer a partially complete or fully complete product.

Partially Complete Equilibrium. Consider an equilibrium in which both firms offer a partially complete product (customer incurs completion costs). The indifferent customer is given by:

$$V - p_A - x_A t = V - p_B - (1 - x_A)t,$$
$$x_A = (p_B - p_A)/(2t) + \frac{1}{2}.$$

The profit for Firm A is: $\pi_A = p_A x_A = p_A[(p_B - p_A)/(2t) + 1/2]$. The optimal prices are $p_A = p_B = t$, market shares are equal, and the corresponding profit equals $\pi_{\text{Partial}} = t/2$.

Deviations: One Firm Offers a Fully Complete Product. Consider a deviation by Firm A from partially complete to a fully complete product. The indifferent customer is given by:

$$V - p_A = V - p_B - (1 - x_A)t,$$
$$x_A = (p_B - p_A)/t + 1.$$

The profits from defecting to a fully complete product are:

$$\pi_A = p_A x_A - (x_A)^2(\beta K/2).$$

In the above expression, the term $(x_A)^2(\beta t/2)$ is the cost to Firm A of completing a product for x_A customers. The first-order conditions lead to: $x_A(1+\beta) - p_A/t = 0$. After substituting the proposed equilibrium price for Firm B, $p_B = t$, this reduces to:

$$p_A = 2t(1+\beta)/(2+\beta).$$

Given these prices, demand for Firm A from defecting to fully complete equals $x_A = 2/(2+\beta)$. Profits from defecting are $2t/(2+\beta)$. Firm A will not defect if

$$1/t \geq 4/(2t + \beta t).$$

This reduces to $\beta \geq 2$. Thus, both firms offering partially complete products at prices of $p_A = p_B = t$ is sustainable provided $\beta \geq 2$.

Fully Complete Equilibrium. Consider an equilibrium in which both firms offer fully complete products. The only candidates for equilibria are those with $p_A = p_B$. To see why, suppose $p_A \neq p_B$. At these prices, one firm has a market share of one and the other has a market share of zero. The firm with a market share of zero would clearly deviate to a lower price. Thus, I only consider equilibria with $p_A = p_B$.

Now consider each firm's cost of product completion in this class of equilibria. Assume that in equilibrium, each firm sells to the half of the market located nearby. The cost of product completion is $\beta t/8$. Now suppose one firm served the entire market. In this case, the total cost of product completion is $\beta t/2$. An equilibrium of (p, p) and fully complete pricing is sustainable for all p that satisfy:

$$\frac{1}{2}p - \beta t/8 \geq (1)p - \beta t/2.$$

In equilibrium, each firm earns $\frac{1}{2}p - \beta t/8$, and a firm that undercut and sold to the entire market earns $(1)p - \beta t/2$. This reduces to $3\beta t/4 \geq p$. While there are many equilibria, I focus on the one with highest profit and $p = 3\beta t/4$. In this equilibrium, profit is $\pi_{\text{Fully}} = \beta t/4$.

Given customer utility of V for an item, the maximum any customer will pay is $p = V$. Thus, the equilibrium prices are $\min(\beta t/4, V)$. If $p = V$, then each firm sells to half the market, completion costs are $\beta t/8$, and total profit is $V/2 - \beta t/8$.

Deviations: One Firm Offers a Partially Complete Product. Consider a defection by Firm A to a partially complete product while Firm B offers a fully complete product. The indifferent consumer is given by:

$$V - p_A - x_A t = V - p_B,$$
$$x_A = (p_B - p_A)/t.$$

The profit of Firm A is:

$$\pi_A = p_A x_A = p_A(p_B - p_A)/t.$$

The first-order conditions lead to $p_A = p_B/2$. The proposed equilibrium has Firm B offering a fully complete product at $p_B = 3\beta t/4$. Thus, the optimal price of a partially complete product for Firm A is $p_A = 3\beta t/8$ and demand of $x_A = 3\beta/8$. Firm A's profit from defecting to a partially complete product are $\pi_A = 9\beta^2/(32t)$. Firm A will not defect from fully complete to partially complete if:

$$\beta t/4 \geq 9\beta^2 t/64,$$
$$16/9 \geq \beta.$$

Thus, both firms offering fully complete products at $p_A = p_B = p = 3\beta t/4$ is sustainable if $16/9 \geq \beta$.

Asymmetric Strategies in Simultaneous Game. Consider an asymmetric equilibrium where Firm A offers a fully complete product and Firm B offers a partially complete product. I show that this equilibrium is not sustainable. For Firm A, a defection to a partially complete product is attractive when firm completion costs are larger. Thus, to prevent defections to partially complete products the firm's cost of product completion must be lower than a threshold ($\beta^{**} \geq \beta$). In contrast, for Firm B, who offers a partially complete product, there is a temptation to undercut Firm A's fully complete product and steal the entire market. However, there is no temptation to undercut if product completion costs are sufficiently large ($\beta \geq \beta^*$). I show that the intersection of these two sets is empty ($\beta^* > \beta^{**}$).

Demand and profits for Firm A are

$$x_A = 1 + (p_B - p_A)/t,$$
$$\pi_A = p_A x_A - (x_A)^2(\beta t/2).$$

One can solve the first-order conditions to obtain p_A and x_A:

$$p_A = (p_B + t)(1+\beta)/(2+\beta),$$
$$x_A = tp_A/(1+\beta).$$

Firm B offers FOB pricing. The profit function of Firm B is

$$\pi_A = p_B(1 - x_A) = p_B(p_A - p_B)/t.$$

One can solve the first-order conditions to obtain $p_B = p_A/2$. Jointly solving these equations, one obtains

Firm A: Fully complete product pricing $p_A = (2t)(1+\beta)/(2+\beta)$,

Firm B: Partially complete product pricing $p_B = (t)(1+\beta)/(2+\beta)$,

$x_A = 1/(2+\beta)$.

The profits for each firm are:

Firm A: Fully complete product $\pi_A = (4-3\beta)t/[2(2+\beta)^2]$,

Firm B: Partially complete product $\pi_B = t[(1+\beta)/(2+\beta)]^2$.

Deviations: From Fully/Partially Complete to Partially/ Partially Complete. Firm *A* considers deviations to a partially complete product. Analogous to previous results, if Firm A deviates to a partially complete product and Firm B offers a partially complete product at $p_B = t(1+\beta)/(2+\beta)$, then

$$p_A = (t/2)(3+2\beta)/(2+\beta),$$
$$x_A = (1/4)(3+2\beta)/(2+\beta),$$
$$\pi_A = (t/8)[(3+2\beta)/(2+\beta)]^2.$$

To prevent Firm A from deviating,

$$(4-3\beta)t/[2(2+\beta)^2] \geq (t/8)[(3+2\beta)/(2+\beta)]^2.$$

This reduces to:

$$(\sqrt{11}-2)/6 = 0.22 \geq \beta.$$

Intuitively, deviating to a strategy where customers pay for product completion is less attractive when the firm is more efficient at product completion (i.e., β is small).

Deviations: From Fully/Partially Complete to Fully/ Fully Complete. Firm B offers a partially complete product in the proposed equilibrium and may have incentive to deviate to a fully complete product. This strategy is attractive because undercutting Firm A by $\varepsilon \sim 0$ steals the entire market. The cost of product completion for the entire market is $(\beta t/2)$. Thus Firm B's optimal deviation leads to profits of $(2t)(1+\beta)/(2+\beta) - (\beta t/2)$. These profits must be less than the equilibrium profits $(t)[(1+\beta)/(2+\beta)]^2$. One can show that deviation to a fully complete product is not profitable for $\beta \geq 1.87$.

Since the intersection of these two regions is the empty set, the pure strategy asymmetric equilibrium is not sustainable.

Comparison of Partially/Partially Complete and Fully/ Fully Complete. For $\beta \geq 2$, both firms offering partially complete products is sustainable. For $\beta \leq 16/9$, both firms offering fully complete products is sustainable. For $\beta \in (16/9, 2)$ there is no pure strategy equilibrium.

Competitive Case Sequential Game. Assume there are two retail locations, A and B, located at either end of a Hotelling line of length one. Assume a different firm owns each retail location. Each firm first announces whether they will offer a fully complete or partially complete product in Stage 1. Then in Stage 2, each firm announces a price. I consider only subgame perfect equilibria.

Stage 2.

Partially Complete Payoffs. These are identical to the proposed simultaneous game equilibrium. $\pi_{\text{Partially}} = t$.

Fully Complete Payoffs. These are identical to the proposed simultaneous game equilibrium. $\pi_{\text{Fully}} = \beta t/4$.

Partially/Fully Complete Payoffs. These are identical to the proposed simultaneous game equilibrium.

Firm A: Fully complete product pricing $\pi_A = (4-3\beta)t/[2(2+\beta)^2]$,

Firm B: Partially complete product pricing $\pi_B = t[(1+\beta)/(2+\beta)]^2$.

Stage 1.
In Stage 1, the payoff matrix is:

		Firm B: Partially Complete	Firm B: Fully Complete
Firm A	Partially Complete	(t, t)	$(t[(1+\beta)/(2+\beta)]^2,\ (4-3\beta)t/[2(2+\beta)^2])$
	Fully Complete	$((4-3\beta)t/[2(2+\beta)^2],\ t[(1+\beta)/(2+\beta)]^2)$	$(\beta t/4, \beta t/4)$

Partially/Partially Complete is an equilibrium if $t \geq (4-3\beta)\cdot t/[2(2+\beta)^2]$ and this condition holds for all $\beta \in [0, +\infty]$. Fully/Fully Complete is an equilibrium if:

$$\beta t/4 \geq t[(1+\beta)/(2+\beta)]^2.$$

This reduces to $\beta \geq 2.383$ for $\beta \in [0, +\infty]$.

An asymmetric equilibrium is ruled out by similar arguments as the simultaneous case.

Bargaining with One-Sided Uncertainty.

Uncertainty over Customer Valuations. Assume that the firm is uncertain about the consumer's product completion costs. I assume that the net valuation of a partially complete product is uniformly distributed between V and $V-t/2$. To solve the two-period game, we consider deriving the optimal price in Period 2. Assume that customers' valuations in Period 2 are uniformly distributed between V^* to $V-t/2$. The probability that the price p_2 is accepted is $(V^*-p_2)/(V^*-V+t/2)$. Given this, the optimal price is $p_2 = V^*/2$.

Consumers in the first period correctly anticipate that $p_2 = V^*/2$. The consumer who is indifferent between buying in the first and second periods is:

$$(V^*-p_1) = \delta(V^*-p_2).$$

After substituting for $p_2 = V^*/2$, one obtains $V^* = 2p_1/(2-\delta)$.

In the first period, the probability that an offer is accepted is $(V-V^*)/(t/2)$. The firm's expected payoff over both periods is:

$$E[\text{profit}] = \bar{\pi} = \frac{V-V^*}{t/2}p_1 + \delta\frac{V^*-V+t/2}{t/2}\,\frac{V^*-p_2}{V^*-V+t/2}.$$

Substituting for V^* and p_2, and then maximizing with respect to p_1, one obtains:

$$p_1 = V\frac{(2-\delta)^2}{2(4-3\delta)}, \quad p_2 = \frac{p_1}{2-\delta} \quad \text{and} \quad \bar{\pi} = V^2\frac{(2-\delta)^2}{2t(4-3\delta)}.$$

Note that the firm's prior beliefs are that valuations are uniformly distributed between V and $V-t/2$. If p_1 is rejected, the firm updates and believes valuations are uniformly distributed between V^* and $V-t/2$.

The price p_1 is less than the single price that clears the market, $V-t/2$, if:

$$V - \frac{t}{2} > V\frac{(2-\delta)^2}{2(4-3\delta)}.$$

This simplifies to:

$$\frac{4-2\delta+\delta^2}{4-3\delta} > \frac{t}{V}.$$

In the monopoly model in §3, we assumed $V > t$ or equivalently $1 > t/V$. One can show that

$$\frac{4-2\delta+\delta^2}{4-3\delta} > 1,$$

which is true for all $\delta > 0$, and therefore $\dfrac{4-2\delta+\delta^2}{4-3\delta} > 1 > \dfrac{t}{V}$.

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