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DURABLE GOODS COMPETITION IN SECONDARY ELECTRONIC MARKETS

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Abstract

We develop a game-theoretic framework to investigate the competitive implications of consumer-to-consumer electronic marketplaces, which promote concurrent selling of new and used goods. In many e-marketplaces, where suppliers cannot directly use second-hand goods for practicing inter-temporal price discrimination, the threat of cannibalization of new goods by used goods become significant. We examine conditions under which it is optimal for suppliers to operate in such markets, explaining why used-goods markets may not be predatory for them. While a monopolist supplier is worse off in the presence of a secondary market, competition can in fact make it better off. The presence of used-goods markets provides an active outlet for some consumers to sell their second-hand goods. Such sales lead to an increase in their disposable income. This increased income can then be used to buy an additional new good. Contrary to conventional wisdom, our model predicts the reduction in the price of new goods when there are used-goods markets. We highlight the strategic role that used goods commission plays in determining optimal profits. Overall, for a wide range of parameters, there is an increase in social welfare from establishing such secondary markets.

Keywords: Used goods resale, quality degradation, supplier competition, budget constraint, game theory, electronic markets

Introduction

“Amazon’s Used-Book Sales Upset Authors” — New York Times, April 10, 2002

“Guild Recommends De-Linking from Amazon” — The Author’s Guild, May 2002.

The recent attempts of some online retailers to sell used books using their Consumer-to-consumer e-marketplace mechanisms has elicited a considerable amount of attention. Judging from the headlines quoted above, it is clear that this practice of online used book sales by both merchants and individuals has not gone done well with publishers. E-tailing giant Amazon.com is fuelling the trend much to the dismay of publishers and suppliers of other goods. According to publishers, Amazon’s high-profile dissemination of used copies eats into their often limited royalties and shortens how long they have to generate new-book sales. This has prompted fears that publishers and suppliers will be forced to boost the prices of new products, in order to extract as high...
a price as they can during the one-time sale of their product. Amazon, however, welcomes the traffic that is generated and the commissions it earns. A recent Wall Street Journal article (July 22, 2002) reports that the roughly equivalent amount of raw profit in each case is why Amazon says it doesn’t really care whether it sells a good from its warehouses or through independent merchants. In fact, secondhand goods are proving to be a money-spinner for Amazon, and the e-commerce site is expanding its policy of paying commissions to its affiliate Web sites to include the sale of used goods. No longer restricted to books, this matchmaking has spread to CDs and even DVDs.

A salient feature of some of these products is that once bought, many consumers derive only a limited utility from keeping them and are willing to resell them, if the transaction costs are negligible. The used good e-market provides access to those consumers who cannot afford to buy the new goods while it offers current owners an outlet to dispose of used goods which still have market value and from which they have already derived their utility. Because of such concurrent selling of new and used goods on the Internet, a fundamental issue here is the strong possibility that used goods can cannibalize the sales of new goods. Conventional wisdom and prior research (Miller 1974) suggests that when suppliers do not draw any royalties from the used-good sales, the opening of secondary markets will force them to increase the new-good prices in order to extract the maximum possible profit from the onetime sale of a new good. In this paper, we attempt to provide some alternate rationale to show that new-good prices need not increase in the presence of second-hand markets.

Research Question, Prior Literature, and Contribution

Does the sale of used goods hurt or benefit suppliers when they cannot accrue any direct profits from secondary market sales? What is the impact of the quality of used goods on new-good prices, suppliers’ profits, and consumer surplus? How does the strategic variable of used-good commission impact profits and prices?

The nature of durable goods markets has long been an active research subject in economics. The difficulty of maintaining the monopoly power on durable goods is due in part to the problem of time-inconsistency, first pointed out by Coase (1972). However, after the early confirmations of the conjecture, other situations were described in which the Coase conjecture does not hold, such as in Kahn (1986). Rust (1986) solves for consumer behavior and prices for used goods in a durable-goods market, with stochastic depreciation. Anderson and Ginsburgh (1994) study how adverse selection would affect the equilibrium in the used-goods market. Waldman (1997) shows how the monopolist could benefit from explicitly interfering with the used-goods market, e.g., through imposing a variable transaction fee on buyers of used goods. Porter and Sattler (1999) introduce a transaction cost for private sellers of used goods, although the manufacturer in their model does not incur a disposal cost. Huang et al. (2001) highlight how consumers also need to worry about time-consistency in their own decision making.

The success of used-goods e-marketplaces, such as that promoted by Amazon, motivates the need to go beyond the existing models. Constructing a comprehensive model that can simultaneously accommodate commonly observed phenomena such as active secondary markets, heterogeneity in consumer preferences, endogenous demand functions, quality depreciation, and the element of product substitutability is the focus of this paper. Before proceeding to discuss the model, we highlight three features that distinguish our work from prior work and lead to our main contributions.

The first feature which distinguishes our model is that we consider two different kind of goods, each being sold by a different supplier, with an underlying heterogeneity in consumers’ purchasing affinity for the two goods. Hence the presence of used-goods markets not only expands the demand for a good of a specific type but also opens up the possibility of some consumers purchasing the second good of another type. This motivates suppliers to compete even more on prices. We show that it is this dual product purchasing behavior of some consumers which plays a strategic role in boosting suppliers’ profits. Indeed, it is the existence of the secondary market, which enables some consumers to indulge in resales which in turn leads to an increase in their disposable income. This increased income can then be used to buy an additional new good.

Second, we begin with a general formulation of underlying utility and then endogenously derive the consumer demand functions, which is different from prior literature where inverse demand functions have been used. Third, in our model, suppliers do not accrue any gains from used-good sales and hence they cannot directly use second-hand goods for practicing inter-temporal price discrimination. All of the direct benefits of the secondary market are captured by the electronic retailer, which acts as an intermediary in our model. This assumption fits well with several electronic marketplaces like those of books, CDs, and DVDs set up by Amazon and E-Bay. In general, it applies to the case of those goods where transaction frequency is much higher while transaction amounts are relatively smaller.
Model

The model consists of two suppliers, $S_A$ and $S_B$, selling goods $A$ and $B$ respectively, through one common retailer, to a unit mass of consumers. The product $i$ ($i \in \{A,B\}$) that is marketed by each supplier is a durable that provides two periods of service. The good is new when it is marketed in period 1 and the same good is classified as used in period 2. In period 1, only new goods are available. In period 2, the retailer opens a used-goods market where consumers can buy and sell used goods with minimal transaction costs set to zero without loss of generality. The retailer sells both the goods, $A$ and $B$, supplied by each of the respective suppliers. Whenever a consumer sells the used good, the retailer gets a commission $k_u$ per used good sold while the remaining $(1-k_u)$ goes to the consumer. Similarly it gets $k_N$ per new good sold, with $(1-k_N)$ going to the supplier. Without loss of generality, we also assume that the marginal cost of each good for the suppliers is symmetric and set to zero.

Consumers are modeled as utility maximizers. Let $\theta$ be a consumer’s valuation for a good, where $\theta \in [0,1]$. The type parameter $\theta$ indicates the heterogeneity in a consumer’s marginal valuation for quality. For any given quality, a consumer with a higher $\theta$ is willing to pay more for the product than one with a lower $\theta$. This type of consumer heterogeneity has been widely employed in marketing and economics literature (Moorthy 1988). Let $1$ denote the quality of the new good and $q$ denote the quality of used good in period 2, where $0 < q < 1$. Thus $q$ can be interpreted as the degree of inter-temporal quality degradation of the new good over two periods. If a consumer purchases a product of quality $q$ at price $p$, his utility is $U(\theta) = \theta q - p$.

In our model, there are two types of consumers. Type A consumers have $\theta$ valuation for good $A$ and $a\theta$ valuation for good $B$ where $a \in [0,1]$. Similarly, type B consumers have $\theta$ valuation for good $B$ and $a\theta$ valuation for good $A$. $a$ is the degree of consumers’ affinity for the other product such that the higher the value of $a$ the more intense is the competition between the two suppliers for inducing consumers to buy their goods. When $a=0$, consumers strictly prefer the specific good $i \in \{A,B\}$ according to their respective types, $i \in \{A,B\}$. However, when $a > 0$, consumers would have an incentive to buy both goods as long as it gives them a positive surplus. We also impose an implicit budget constraint $BC$ for the consumers in the form of disposable income for goods. Having bought a new good in period 1, consumers can either hold on to a used good or sell it in the marketplace in the second period. Intuitively, we would expect that for the same used good, a consumer holding the good will derive less utility than a used-good buyer. Therefore, we assume that while the buyer of a used good derives a utility of $q$ from consuming the good, the holder of the used good derives a utility of $h$, where $h < q$. To motivate this discussion, consider a good such as a DVD or a fiction novel. Once a consumer has seen the movie or read the novel, her utility from the content per se of the product might reduce considerably. As such, she will derive a reduced utility from holding the good. Conversely, a buyer of the same used DVD or novel can derive a much higher utility from the content of the good.

The game is modeled as a multistage process across two periods. We consider a subgame perfect equilibrium of this game using backward induction. First, suppliers choose optimal new-good prices simultaneously. Then two events occur simultaneously. Market forces determine the optimal price of used goods from clearance conditions. At the same time, consumers choose a combination of strategies to maximize their surplus over two periods and demand is realized.

Noncompetitive Equilibrium

Since there is no used-goods market, consumers buy the good in the first period and hold it in the second period. Let’s denote the price of the new good in the absence of a used-goods market as $p_n$. This ensures that when the supplier sells their goods at monopoly prices, buyers have enough income to buy it. From the incentive compatibility (IC) and individual rationality (IR) constraints, consumers of both types in both markets, buy a good as long as $\theta(1+h) - P_n > 0$. Hence the demand for a new good
(both A and B) is \( D(P_N, q) = 1 - \frac{P_N}{1 + h} \). The profit for each supplier, \( \pi_s = (1 - \frac{P_N}{1 + h})(1 - k_N) P_N \) from which the optimal price is \( P^*_s = \frac{1 + h}{2} \). At this price, each supplier makes a profit of \( \pi_s = (\frac{1 + h}{4})(1 - k_N) \) while the total profit of the retailer from both the markets is of \( \pi_r = \frac{(1 + h)}{2} (k_N) \).

**Proposition 1:** For all \( a \in (0.0, 0.61) \), there exists a symmetric pure strategy Nash equilibrium such that both suppliers offer the monopoly price \( (P^*_N, P^*_N) \). In this equilibrium, consumers buy only one good.

In the case of new goods, the profit maximizing price for the retailer and suppliers is the same. In the case of used goods, as we show later, strategies for the retailer and suppliers change because while the retailer still gets a commission for each used good sold, the suppliers do not. It is this differential incentive for used-good sales between suppliers and retailers and the consequent implications for equilibrium profits that we explore in this paper.

**Competitive Equilibrium**

In the previous equilibrium, we showed that both suppliers simultaneously offer monopoly prices and consumers only buy one good. Suppose both suppliers decide to deviate from their monopoly prices \( p_{mn} \) and get some of the type \( i \) (\( j \)) users to buy good \( j \) (\( i \)) and vice versa. Suppose \( S_A \) (\( S_B \)) offers price \( P_A^{low} < P_N \) such that in type B (A) market, some consumers find it incentive-compatible to buy both goods A and B at lower prices as long as it satisfies their individual rationality (IR) constraint. Hence the type B (A) market gets split into two segments, such that the higher willingness-to-pay consumers buy their preferred good B (A) and good A (B) while the remaining buyers buy only good B (A). As is immediate, all type B consumers between 1 and \( th \) also buy from \( S_A \). This situation is depicted in the Figure 1

![Figure 1. Market Segmentation in Accordance with Consumer Buying Strategies](image)

**Lemma 1:** When suppliers can sell two goods to some consumers, the optimal price and supplier profits are given by \( \frac{(1 + h)\alpha}{1 + \alpha} \) and \( (1-k_N) \frac{(1 + h)\alpha}{1 + \alpha} \) respectively.

Note that in order for consumers to buy both goods they should have a disposable budget constraint \( (BC) \) equal to \( 2 \frac{(1 + h)\alpha}{1 + \alpha} \).

We proceed to show that this budget constraint is significantly lowered due to the establishment of secondary electronic markets and, in the long term, it is this feature that will lead to an increase in supplier profits in the presence of used-goods markets.

**Retailer Establishes a Secondary E-Marketplace**

One major goal of this paper is to show that, for a finite budget constraint, users can buy only one good in the absence of a used-goods market. But in the presence of a used-goods market, for the same budget constraint, some users can buy both goods. Further, when transaction costs are low, as on the Internet, the budget constraint for which this behavior holds will be milder than when there are significant transaction costs, as in the offline world. To illustrate briefly with an example to motivate the discussion so far, suppose a consumer has a disposable income of $100 for buying books and that the prices of two books that he desires
to buy are $65 each. Given his existing income, on his own he is unable to buy them both. However if he buys one book and then is able to resell it for $30, his total budget in the second period is $65. Thus the used-goods market increases his disposable income, enabling him to buy the second book as well.

Figure 2. Transaction Mechanism with Secondary Electronic Market

At the beginning of each period, when consumers evaluate their needs over the two-period horizon, they can follow one of the five independent strategies laid out below. Let N, H, S, U and I denote a single period action, corresponding to buying a new good of type i, holding onto a used good, selling a used good, buying a used good, and remaining inactive by not buying any good.

Monopoly Revisited

In the absence of competition, that is, when \( \alpha = 0 \), consumers always buy their preferred good according to the type of the market to which they belong. That is, consumers of type A(B) buy only good A(B). The figure below describes the segmentation of the market based on the consumer action strategies. Let \( P_N \) and \( P_S \) denote the new good and used good prices, respectively. Hence the corresponding utilities derived from various action strategies are as follows:

1. (NH) Buy new good in period 1 and hold onto it in period 2: \( \theta (1+h) - P_N \)
2. (NS) Buy new good in period 1 and sell it in period 2: \( \theta - P_N + (1 - k_u) P_S \)
3. (IU) Remain inactive in period 1 and buy used good in period 2: \( \theta - P_S \)
4. (II) Remain inactive in both periods: 0

By equating the IR and IC constraints based on these four strategies, we derive the three indifferent points \( \theta_1 \), \( \theta_2 \), and \( \theta_3 \), which define the consumer market segments. It is important to recognize that in our model, based on suppliers’ pricing strategies, the number of consumers in these groups will emerge endogenously. Since the used-goods market is competitive, the price of used goods, \( P_S \) will also be endogenously determined. This ensures that clearance conditions will equalize demand and supply of used goods at all times. By equating the demand of used goods with the supply of used goods, we get the market clearing second period price. Hence the supplier’s profit equation is given by

\[
\pi_S = (1- \theta_1 + \theta_2 - \theta_3)(1-k_u)P_N
\]
**Proposition 2:** The suppliers’ profits decrease with the establishment of a used-goods market while the retailer’s profits increases.

The presence of an active used-goods market creates competition for new goods because the option of buying used goods is now incentive compatible for some consumers who would have bought new goods before. This enhanced competition forces suppliers to decrease the new-good prices in order to remain competitive with used goods. Recall that the supplier cannot derive any benefit from the sale of used goods, since all proceeds from the sale of used goods (i.e., the commission fees) are shared between the retailer and the consumers. The price of new goods $p_n$ decreases from the case when there is no used-goods market. With market share remaining unchanged, this leads to lower profits for the supplier. On the other hand, if we were to compare the profits of the retailer, we observe that the retailer’s profits increase by opening up of the secondary electronic market. The loss from the reduced profits from the NH and NS segments is more than offset by the gain from used-good sales in the IU segment. Therefore, it is immediately clear that Amazon always has had an incentive to establish a used-goods market because it is always better off.

Interestingly, we observe that, for a monopoly supplier, the quality of used goods does not influence the number of new goods sold. This is because the implicit quality degradation cost borne by consumers is proportional to the valuation of the consumers for the original good, theta, and hence the new good price adjusts endogenously. This leads consumers to self-select in such a way that, although the supplier loses some new-good sales in the NH segment, it makes up for those lost sales in the NS segment and thus the total segment of new good buyers remains at one-half.

**Proposition 3:**

1. The optimal new-good price and supplier profits always decrease with used-good quality $q$ but increase with used-good holding utility $h$. (1) The optimal used-good price increases monotonically with both the used-good attributes, $q$ and $h$. (3) The optimal new-good and used-good price increases monotonically with an increase in the used-good commission, $k_u$. (4) The establishment of a secondary used-good marketplace leads to an increase in consumer surplus. (5) Supplier profits decrease with used-good commission $k_u$.

When the used-good price increases due to an increase in quality $q$, then the supplier’s best response is to decrease $p_n$ to compete head-to-head with used goods. But when the used-good price increases due to supply considerations like changes in $k_u$ or $h$, then the supplier’s best response is to increase $P_N$. Our model suggests that suppliers gain if consumers derive a higher value from holding the new good. The intuition behind this is that, with an epsilon change in $h$, although there is no change in the total number of new goods sold (NH+NS), there is a reallocation of consumers between the NH and NS segments. Since the utility of the NH segment increases with $h$, the supply of used goods decreases due to the larger NH and smaller NS segment. Since the demand of used goods does not change, the reduced supply of used goods leads to an upward thrust on the used good prices which in turn causes the new good price to increase as well. The increase in prices, with an unchanged total new good demand, results in an increase in supplier’s overall profits with increasing $h$.

We show that ex post consumer welfare increases with the establishment of used-goods e-markets since there is a new segment of used-good buyers who are a pure addition to the total number of existing new-good buyers. These consumers could not afford to buy new goods earlier but are now able to at least afford used goods. Additionally, new-good buyers gain from reduced new-good prices and this increases their surplus.

As $k_u$ increases, consumers get less utility from selling the used good, compared to holding it. Hence the NH segment increases in size while the NS segment shrinks in size. While the supply of used goods shrinks, the demand remains unchanged. This causes the used-good price to increase, with $k_u$. However with an increase in $P_N$, $P_N$ also increases, which puts a downward thrust on demand for new goods. Consequently this leads to a decrease in supplier profits with increasing $k_u$.

**Duopoly: Inter-Supplier Competition**

Will the suppliers gain or lose if the captive consumers in their own markets also desire to buy the goods of the other supplier—that is, from their competitors? In this section, we proceed to answer this question by introducing the element of competition. Since $\alpha > 0$ now, there will always be some consumers who will buy one good each from both the suppliers, as long as it gives them a positive surplus. This leads to the creation of a new segment which we term as NSN. The dominant consumer strategies and corresponding utilities are as shown in Figure 3.
Figure 3. Consumption Classes by Consumer Type $\vartheta$ in Market $i$, $i \in (A, B)$

Proposition 4: Consumers in $(1, \vartheta)$ will follow $\text{NSN}$, consumers in $(\vartheta, \vartheta_2)$ will follow $\text{NH}$, consumers in $(\vartheta_2, \vartheta)$ will follow $\text{IU}$, and those in $(\vartheta, 0)$ will follow $\text{II}$.

All consumers from 1 to $\vartheta_1$ create the supply $S$ of used goods. All consumers from $(\vartheta_2, \vartheta)$ create the demand $D$ for used goods. Therefore, by equating $D$ and $S$, we get the market clearing used-good price $P_S^*$. The optimal new-good price $P_N^*$ can be derived from the supplier’s profit equation, after substituting for $P_S^*$. Note that the new-good sales occur first in two segments, that is, in the NSN and NH segments. Also since the NSN segment in both the consumer markets, $i$ and $j$, buys from both the respective suppliers, each supplier gets twice the NSN segment of the market. Hence, the supplier’s profit equation is $\pi(S) = 2(1 - \vartheta_1)(1 - k_N)P_N + (\vartheta_1 - \vartheta_2)(1 - k_N)P_N$. Whether monopoly or competition benefits suppliers is determined by $\alpha$. There exists a critical value of $\alpha_c$ such that compared to the monopoly regime, supplier profits increase with the introduction of inter-supplier competition for any $\alpha > \alpha_c$. Thus for any $\alpha$ which exceeds the critical value, suppliers make higher profits despite having to implicitly compete with each other. The NSN segment thus plays a critical role in this scenario. The existence of this segment leads to two countervailing effects for the suppliers. In order to incentivize consumers in the other market, $j$, to buy their less preferred good, supplier $i$ will need to lower its price. This causes profits to fall. However, it is precisely this reduction in price that leads to additional sales from the NSN segment of supplier $j$, since these consumers can afford to buy both the goods. This is the market expansion effect, which puts an upward thrust on the profits. These two countervailing forces lead to a situation wherein, depending on the value of $\alpha$, suppliers end up making higher profits than in the monopoly case.

Proposition 5: The supplier’s optimal new-good price $P_N^*$ in the presence of a competitive used-goods market is lower than the optimal new-good price $P_N$ in the absence of an used-goods market.

Counterintuitively, we find the used-goods marketplace actually leads to a decrease in the price of new goods. One would conjecture that suppliers would increase the new good prices so as to extract the maximum consumer surplus from the first period sale. The intuition underlying this follows from two effects. The first is that since used goods and new goods compete with each other, the supplier has an incentive to discount new goods more sharply, to strengthen their sales and compete effectively with used goods in period 2. We call this the inter-temporal price competition effect. In addition to this direct effect, the existence of consumers’ affinity for the second good also induces suppliers to price their new good lower than the monopoly price, so as to gain the additional sales in the other supplier’s market. This is the market expansion effect described earlier. These two effects act in sync with each other and bring down the new-good prices.

Proposition 6: If consumers have an implicit budget constraint $BC$ such that, $2P_N^* - (1 - k_N)P_S < BC < 2P_N^*$, then suppliers’ profits increase with the establishment of a used-goods market, compared to the no-used-goods market scenario.

The intuition for this is that offering a market for used goods provides some consumers an incentive to sell their good. This increases their disposable income, thereby allowing them to buy an additional new good. In particular, the NSN segment is now able to buy the second (less preferred) good from the other supplier as well. This behavior is reinforced by the fact that due to the two effects outlined earlier, the price of the new good also decreases in comparison to the scenario in which the used-goods market was absent, thereby enabling a larger mass of consumers to buy new goods.

Thus, the important economic effect of the consumer-to-consumer electronic exchanges is that it creates a segment of consumers, NSN, which is able to buy the second new good by virtue of the extra income through sales of their used good. In effect the used-good option is like a rebate coupon which reduces the net price that consumers actually pay for the new good. That is, the selling price of the new good $P_N$ in period 2 effectively becomes equal to the sum of the new-good price in period 1 minus the expected
used-good price in period 2. This intuition is corroborated by the fact that as the used-goods commission charged by the retailer \( k_u \) decreases, supplier profits increase because consumers in the NSN segment then have a higher disposable income, enabling them to buy both the new goods.

**Proposition 7:** (1) For low values of \( q \), the new-good price \( P_N \) decreases with the used-good commission \( k_c \) while for high values of \( q \) it increases with \( k_u \). (2) The new-good price \( P_N^* \) always increases monotonically with \( \alpha \), consumers’ degree of preference for the second good.

In contrast to the monopoly regime, the used-good commission plays a strategic role. On one hand, increasing \( k_u \) leads to higher profits for the retailer since it then usurps a higher percentage of used-goods profits. However, a higher \( k_u \) also implies a lower income for consumers in the NSN segment, which in turn adversely affects the sales of the second new good. For a broad range of parameter values, we find that \( k_u \) has an adverse effect on the new-good price. As \( k_u \) increases, consumers will get a reduced benefit from selling the used good, compared to holding it. Hence the NH segment increases in size while the NSN segment shrinks in size. The reduced supply of used goods imparts an upward thrust to the used good price and consequently the new-good prices. Further, the incremental demand from the new-goods segment (NH-NSN) also has a price increasing effect. However, this effect is also offset by a downward thrust from the suppliers on new-good prices in order to expand the NSN segment. In order to induce more people in the other market \( j \) to buy the second new good, the supplier \( i \) decreases its new good price, \( P_N \). This market expansion effect is stronger than the former inter-temporal price competition effect, leading to an overall decrease in prices and increase in new-good sales.

Figure 4 shows the prices and the budget constraint, \( BC^N \), in the absence of used-goods markets. Figure 5 shows how the BC is lowered (\( BC^U < BC^N \)) due to the presence of used-goods markets. The NSN segment thus plays a critical role in this scenario. The existence of this segment leads to two countervailing effects for the suppliers. In order to incentivise consumers in the other market, \( j \), to buy their less preferred good, supplier \( i \) will need to lower its price, \( P_N^* \). Further, by selling the good in the second period, the NSN segment gets an additional income of \((1 - k_u)P_S \).

Both of these effects cause the budget constraint to decrease from \( BC^N \) to \( BC^U \). This reduction in \( BC^U \) leads to additional sales from the NSN segment of supplier \( j \), since these consumers end up buying both the goods. This is the market expansion effect, which puts an upward thrust on the profits. Thus by reducing the required BC, suppliers end up making higher profits than in the no-used-goods market case.

**Observation 1:** (1) There exists a critical value of \( \alpha_{dm} \) such that, compared to the monopoly regime, supplier profits increase with the introduction of inter-supplier competition, for any \( \alpha > \alpha_{dm} \). (2) Consumer surplus increases with inter-supplier competition in secondary e-markets.
Whether, monopoly or competition benefits suppliers, is determined by $\alpha$. Figure 6 shows that for $\alpha \in (0.35,1)$ and $\alpha \in (0.0,35)$ and $k_u = 0.1, h = 0.1$, suppliers are better off despite the implicit duopolistic competition. It is quite intuitive to see why consumer surplus (CS) increases when there is inter-supplier competition in the presence of used-goods markets. The first effect is due to the lowering of the new-good prices. Further, there is an expansion in the demand for new goods. Additionally some consumers who were shut out of the market for new goods are also able to afford to buy used goods. Since suppliers profits also increase for any $\alpha > \alpha_{\text{min}}$, total welfare increases with the establishment of secondary electronic markets. For any value of $(k_u, h)$ and for all $\alpha$ in $(0.1,0.8)$ and for all $q$ in $(0.1,0.8)$ we observe that when suppliers are competing with each other in the concurrent selling of new and used goods, the consumer surplus is higher than the case without used goods as shown in Figure 7.

**Figure 6. Difference in Consumer Surplus**

**Figure 7. Difference in Profits with Used Goods (Duo-Mono)**

**Observation 2.** For $\alpha$ in $(0.0,35)$, supplier’s profits increase with increase in used-good quality $q$, for all $q$ in $(0.0,5)$. As alpha increases beyond this range, suppliers’ profits decrease with $q$.

Intuitively, as alpha increases, suppliers can afford to charge them higher prices. At low values of $q$, the supplier perceives less of a threat from used goods and so he can increase the new-good price as alpha increases. The market expansion effect dominates here. However as $q$ increases, the used-good prices also increase, which in turn leads to lower new-good prices to enable the new good to compete head to head with used goods. This is the inter-temporal price competition effect. At high levels of $q$, this effect is stronger than the market-expansion effect, leading to reduced profits. Observation 2 has an interesting implication. Since used-good quality is an exogenous parameter for retailers or suppliers, it cannot be chosen endogenously by them. Our paper highlights that used goods may not always be detrimental for suppliers.

**Conclusion and Implications**

Information technology facilitates the delivery of many products and services over newly emerging secondary electronic networks. As these electronic networks develop and mature, it will be important to quantify their impact on supplier and retailer profits and consumer welfare. There has been a lot of strife between suppliers and retailers in the recent past over the damage which such secondary electronic markets are supposedly causing to the profits of suppliers. The general consensus is that since used-good sales cannibalize new-good sales, secondary e-markets established by brokers like Amazon and E-bay are necessarily a bane for suppliers. Using a game-theoretic model, we investigate the competitive implications of these newly emerging e-marketplaces on consumer surplus, suppliers’ prices, and profits. The purpose of our work is to highlight some of the important economic properties of secondary consumer-to-consumer e-marketplaces which are cropping up on the Internet and causing a furor among suppliers in industries such as book publishing and music. The insights from this model help to explain several interesting market phenomena including (1) the profitability of concurrent sales of new and used goods, i.e., why used-goods markets may not be detrimental for suppliers, (2) the reduction in the price of new goods when there are used-goods markets, (3) the significant effect of used goods commission fees on equilibrium prices and profits, (4) why an increase in the used goods quality may not necessarily be a cannibalization threat for new goods, and (5) the overall increase in social welfare that accrues from establishing such secondary electronic markets.
We show that the major motivation of the retailer to establish a used-goods market is to capture additional surplus from those consumers who were shut out of the new-goods market. This enables it to effectively practice price discrimination. Our model also highlights that, compared to a monopolistic market, inter-supplier competition can be beneficial to suppliers in the presence of a secondary market, rather than being harmful. This occurs because the presence of used goods subdues the rate at which suppliers can increase the new-good prices with consumers’ cross-product purchase affinity. This then expands the market in such a way that the market-expansion effect compensates for the price-competition effect. Thus, we show that, contrary to popular perceptions, the presence of a used-goods market is beneficial for suppliers too, under a relatively wide range of conditions. When advertised as a deep discount option for a new good, secondary electronic markets offer an extremely attractive option to increase disposable income and thereby stimulate more new-goods sales.

Our analysis has implications for durable goods in which suppliers sell through intermediaries but cannot accrue any direct gains from secondary markets. As long as there is more than one supplier, and consumers are willing to buy another new good, a secondary market can be useful for suppliers. Another implication from our model is that while deriving their optimal pricing strategies, suppliers need to keep in mind the impact of a positive holding utility that some consumers derive from used goods. Ignoring this aspect of consumer behavior will drive up the price beyond the optimal value. This implication also holds good for a retailer while deriving its optimal used-good commission.

In light of the ruckus created by publishers over Amazon’s practice of using their marketplace mechanism to sell used goods and a call for government intervention in such markets, this result can have some public policy and managerial implications. Based on the result that total welfare increases, our model suggests the strong possibility of a win-win situation for suppliers, retailers, and consumers alike from the establishment of used-goods marketplaces.

References


Appendix

**Proof of Proposition 1**

Suppose $S_A$ (selling book A) decides to deviate from its monopoly price $P_N$ and offers price $P_1 < P_N$. Then in its own market A, demand $D^A_1$ for good A from type A users at $P_1$ is $I - \theta^A = 1 - \frac{P_1}{1 + h}$. In the type B market, some consumers will find it incentive compatible to buy their less preferred good A at a lower price as long as it satisfies their (IR) constraint. Therefore, we have $\theta q^B (1 + h) - P_N > a\theta (1 + h) - P_1$ and $a\theta (1 + h) - P_1 > 0$. Hence demand $D^B_1$ for good A from type B users at $P_1$ is $\theta^B - \theta^A =$
Thus total demand \( D(P) = D_1^{A} + D_1^{B} \). Hence the profit equation is

\[
\pi_S = P_1(1 - k_S) \left[ \frac{\alpha P_N - P_1}{\alpha(1 - \alpha)} - P_1 \right] + 1.
\]

Optimizing the profit equation after substituting the monopoly price \( P_N \) gives us the optimal price \( P_1^* \). Substituting \( P_1^* \) in, we get the optimal supplier profit equation as

\[
\pi_S(P_1) = \frac{(1 - k_S)(2 - \alpha)(1 + h)}{(16 - \alpha)}.
\]

Comparing this to the monopoly profits equation and solving for positive values of \( \alpha \) provides the critical value of \( \alpha = 0.61 \) beyond which \( S_A \) finds it profitable to offer \( P_1^* \).

**Proof of Proposition 2**

(1) Comparing the profits of the suppliers with and without used-goods markets, we find that profits in the absence of used-goods markets \( \pi_S(P_N) \) will be higher than that with used-goods markets \( \pi_S(P_N \{\alpha^*\}, P_S \{\alpha^*\}) \) iff \( 1 + h - k_U > 0 \) which is true.

(2) Comparing the profits of the retailer with and without used-goods markets, we find that profits in the absence of used-goods markets \( \pi_R(P_N) \) will be higher than that with used-goods markets \( \pi_R(P_N \{\alpha^*\}, P_S \{\alpha^*\}) \) iff \( 1 + h - q > 0 \) which is true.

**Proof of Proposition 3**

The first derivative of new good prices with respect to quality \( q \) and \( \alpha \), are given by \( \frac{\partial P_N}{\partial q} < 0 \) and \( \frac{\partial P_N}{\partial \alpha} > 0 \). The optimal supplier profit equation is

\[
\pi_S(P_N, P_S) = (1 - k_s)(1 - k_U)(1 - q) + h(1 + (3 - 2k_U)q)
\]

and retailer’s profits is

\[
\pi_R(P_N, P_S) = \frac{k_S \pi_S}{1 - k_S} + \frac{hk_U q((1 - k_S)q - h)}{2(h + q - k_S q)}.
\]

Comparing with the no-used-goods market supplier profit with consumers buying only one good, the difference in retailer’s profits is \( > 0 \) and that in supplier’s profits is \( < 0 \). Consumer surplus (CS) in the absence of used goods is given by

\[
CS_N = \int_{1/2}^{1} \theta + \theta h - P_N = \frac{1 + h}{8}.
\]

Total consumer surplus (CS \( \tau \)) from the NH, NS, and IU segments is given respectively by

\[
\int_{\theta_1}^{1} \theta(1 + h) - P_S + \int_{\theta_2}^{\theta_3} (\theta - P_N + P_S(1 - k_U)) + \int_{\theta_4}^{\theta_5} (\theta - P_1).
\]

We find that the difference \( CS_{\tau} - CS_N = \frac{(1 - k_U)q - h)(3(1 - k_U)q^2 - 3h^2 + h k_U (5q - 4k_U)q)q}{8(h + q - k_U q)^2} > 0 \).
Proof of Proposition 4

Apart from the four strategies stated in the proposition, consumers could adopt any of the two following strategies: NSU and IN. We shall now proceed to eliminate these two strategies.

(1) Utility from following an NSU strategy \( U_{NSU} = \theta(l + \alpha h) - P_N \cdot P_S + (l - k_U)P_S \)

(2) Utility from following an IN strategy \( U_{IN} = \theta(l + h) - P_N \)

Comparing NH and NSU, we find that \( U_{NH} - U_{NSU} = \frac{4(1 + h)(1 + h - q) + (2 - k)q^2}{2(1 + \alpha + ah) - k_U q} - (1 + h - q) \). Since \( \theta \in (0,1) \) the equilibrium exhibits the following property \( 0 < \theta_1 < \theta_2 < \theta_3 < 1 \). We know that \( 1 + h - q > 0 \) and since \( \theta_i > 0 \) this implies that \( \alpha + ah - h > 0 \). Hence the result follows.

Proof of Proposition 5

Compare the new book price in the presence of a used-goods market given by, with that in the absence of a used-goods market given by \( \frac{1 + h}{2} \). The difference between the two prices is given by \( \frac{1}{2} \left[ \frac{4(1 + h)(1 + h - q) + (2 - k)q^2}{2(1 + \alpha + ah) - k_U q} - (1 + h - q) \right] \). Since \( \theta \in (0,1) \) the equilibrium exhibits the following property \( 0 < \theta_1 < \theta_2 < \theta_3 < 1 \). We know that \( 1 + h - q > 0 \) and since \( \theta_i > 0 \) this implies that \( \alpha + ah - h > 0 \). Hence the result follows.

Proof of Proposition 6

From the demand supply clearance condition for used goods, we get \( P_N (P_N) \). Plugging this back in the equation and maximizing it w.r.t. price \( P_N \) we get \( P_N \{ \alpha^* \} \). This in turn gives us \( P_N \{ \alpha^* \} \). Taking the second derivative of the supplier’s profit equation, we find that \( \frac{\partial^2 \sigma_S}{\partial P_N^2} = -(1 - k_N) \frac{2(1 + \alpha + ah) - k_U q}{(1 - k_U)(1 - q)q + \alpha - h^2(1 - \alpha) - h(1 + k_U q - q - 2q)} \). Since \( k_U < 1 \), it is immediate to show that the equation < 0. This proves that \( P_N \{ \alpha^* \} \) is a maxima and hence \( BC_U < BC_N \).

Proof of Proposition 7

This follows from the partial derivatives

\[
\frac{\partial P_N}{\partial \alpha} = \frac{(1 + h)(4(1 + h - q) + (2 - k_U)q^2)h}{(2 - k_U q + 2(1 + h)\alpha)} > 0
\]

and

\[
\frac{\partial P_N}{\partial k_U} = \frac{q(-2 - 2h - h^2(4 - q(2 + \alpha) + q(3 - \alpha)))}{(2(1 + \alpha + ah - k_U q)^2)} > 0
\]

for lower values of \( q \) and \( \frac{\partial P_N}{\partial k_U} > 0 \) for higher values of \( q \).