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Shopping hours and bundling as an entry barrier[*]

José María Chamorro Rivas[†]

Abstract. This paper presents a simple model of regulated/deregulated shopping hours and bundling in markets where consumers have preference in shopping time. We show that, for a range of parameters, the market will change from a duopoly with an independent pricing regime when shopping hours are regulated, to a monopoly regime with bundling of products, when shopping hours are deregulated. For the rest range of parameters, market structure does not change after deregulation. Finally, deregulation tends to increase the range of parameters over which bundling is a profitable strategy. Thus, the message of this paper is that deregulation increases the strategic incentive to bundle as a mechanism to deter entry.

JEL: L11, L13

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1. Introduction

Bundling consists of selling two or more products in fixed combination. Bundling of products commonly occurs in many sectors of the economy. Examples are found across a range of products from several industries including the IT industries, food, apparel, cosmetics, and entertainment. Most of these bundles are composed of retail products such as shampoo and conditioner, concert tickets and CDs, computers and printers, and PC software.

There are several strategic reasons why bundling can be profitable.[1] One explanation that economists have given for bundling is that it can serve as a tool to sustain or create market power.[2] Whinston (1990) was the first to demonstrate this result by considering two markets of products. He showed the advantages of bundling when one seller has a monopoly in a product A and faces a competitor in another differentiated product B.[3] In his model, bundling commits the monopolist to being more aggressive against the competitor, and this commitment may discourage entry.[4] He shows that bundling serves as a mechanism to reduce the sales of the competitor. Intuitively, bundling commits the monopolist to sell to a consumer buying product A also product B. This puts the consumer into the position to choose between either only product B, which is bought from the competitor, or between buying both products from the monopolist. And from the perspective of the monopolist this implies that losing a consumer to the competitor

[1] There are also technological reasons for bundling, see, for example, Salinger (1995). Take, for instance, cars, which represent a bundle of components sold in the same product. However, we will focus on why bundling can be profitable for strategic reasons. The existing literature on bundling for strategic reasons falls broadly into two categories: the price discrimination theory and the leverage theory.

[2] Issues of bundling have received much interest in the empirical literature. We find some examples in the world of business such as the GE-Honeywell merger, see Nalebuff (2001) for a discussion; in the newspaper advertising industry in Canada, see Slade (1998); and in contracts and competition in the pay-TV market, see Harbord and Ottaviani (2001).

[3] The arguments that have tried to justify the leverage theory have been the cause of great controversy in the literature of bundling. So, an argument against the leverage theory says that when there is perfect competition in the market for the non-monopolized product, it is not possible to leverage the monopolistic power enjoyed in the monopolized market into the other market. Thus, we need some elements of imperfect competition to make bundling a profitable leverage strategy. See, for example, an explanation of this argument in Gal-Or (2004). In a different context of the leverage theory, Carbajo et al. (1990) also show that imperfect competition can create a strategic incentive to bundle.

[4] Whinston (1990)'s reason to leverage monopoly power relies on a commitment of bundle both products. There are other models where this consideration is not necessary. For example, Nalebuff (2004) proposes a different mechanism of action where bundling is credible without any commitment device.

reduces both the sales of products A and B. This makes the monopolist more aggressive, which reduces the price of product B and also the potential market share of the competitor. Finally, such foreclosure may lower the competitor's profits below the level that would justify continued operation.

However, when bundling products deters entry to the competitor, the monopolist may or may not find it profitable to do so. The monopolist will use the bundling strategy if there is any gain from converting market B from a duopoly with independent pricing to a monopoly with the bundling of both products. Thus, the presence of a large number of consumers who strongly dislike the monopolist's variety of product B will determine whether or not making the commitment to bundle is unprofitable, even when it leads to exclusion. Hence, a crucial assumption behind this model is that consumers must be heterogeneous in terms of the valuation of product B.

In trying to accommodate changing lifestyles (increases in the numbers of working women and of families in which all the adults work), more and more consumers, take into account shopping hours when making buying decisions. This fact introduces one more feature to consumers' characteristics that may have significant consequences on sellers' strategic decisions. Theoretical and empirical literature has analyzed diverse potential effects of shopping-hour deregulation on economic variables, giving arguments for or against liberalization.[5] In this work, we focus on a possible consequence of this liberalization that, so far as is known, has not been analyzed before, at least, from a theoretical point of view. Can we expect a possible reversion in the profitability of bundling with the liberalization of shopping hours? If that were the case, liberalization could increase the market power of some sellers through deterring the entry of competitors in some markets, which in turn might upset anti-trust authorities.

Shopping-hour regulation is one of the key current issues in many countries. Although the general policy of restricting opening hours has not been abandoned in many countries, some of them such as Portugal, Sweden, UK, German, Canada, etc. have already decided on complete or some degree of liberalization. Governments have subsequently relaxed their regulation, increasing the hours during which stores may be

[5] See, for example, some of these arguments in Lanoie and et al. (1994)

open and/or permitting them to open on Sundays. There are several academic works that analyze shopping-hour deregulation mainly in European and American countries. Among them, the paper of Jacobsen and Kooreman (2003) analyzes the effects of changing shopping hours in the Netherlands, and Lanoie et al. (1994) analyze the short-term impact of shopping-hour deregulation in Canada. From a theoretical perspective, Inderst and Irmen (2005) make endogenous the retailers' choice of opening hours, Kosfeld (2002) makes an analysis of coordination between customers and retailers, and Shy and Stenbacka (2004) analyze the effects of consumers' shopping time flexibility by comparing bi-directional consumers with forward- or backward-oriented consumers.

The existing literature on the effects of shopping-hour deregulation on market structure has developed ambiguous predictions on how market structure responds. In many countries there is significant opposition to deregulation which comes not only from conservative sellers who fear a change in market structure but also from many consumers who expect that higher prices will follow deregulation. An immediate effect of liberalization is the change in consumers' valuations. Once there is a liberalization of shopping hours, consumers need not to incur time disutilities since they can adjust their shopping to their preferred time intervals. This change in consumers' valuations can affect the profitability of a bundling strategy. Consequently, consumers' and sellers' fears regarding shopping-hour deregulation may be justified in those markets where bundling could be used to expand monopoly power, since sellers may not necessarily maintain the same strategies in the new context. Thus, the key issue is to answer the question of whether consumers and sellers would be better off in the new situation.

This paper wants to shed some light on the impact of deregulation of opening hours on the strategic incentive to bundle products when bundling can serve as a tool of entry deterrence. We show that, for a range of parameters, bundling is an effective entry-deterrent strategy in response to liberalization. After deregulation, a seller with market power in two products can, by pre-committing to bundle them together, induce the exit of a rival seller that sells only one of these products. We will be also concerned about the implications of deregulation on product prices and social welfare.

We study this question in a model with horizontal product differentiation based on Whinston (1990). We consider there are two sellers and two independent products.

Product A is monopolized by seller 1 and product B is a (spatially) differentiated good that is sold by sellers 1 and 2. Consumers have preferences on "spatial" product characteristics and on the hour to go shopping. Allowing for time heterogeneity introduces the originality of this model. Each consumer wants at most a single unit of each product. We also assume that seller 1 is able to pre-commit to bundling via its choice of which goods it will be able to produce before both firms establish their prices. Seller 1 can choose between producing both goods individually or bundling them. Finally, we study and compare a regulated and a deregulated market.

Two main features of the model yield the incentives to bundle when shopping hours are deregulated. Interestingly, these two features have opposing effects on the profitability of bundling. On the one hand, as consumers have a preferred hour to go shopping, the deregulation of shopping hours may be viewed as a means to increase product valuation for consumers who have a higher preference for unrestricted shopping hours. Sellers increase profits and it is more difficult to exclude the monopolist's rival by reducing the rival's profits. On the other hand, the monopolist has to charge one price to all consumers. Hence, variability in customers' valuations of time shopping frustrates the monopolist's ability to capture consumer surplus. Deregulation helps to reduce this heterogeneity and makes the monopolist earn greater profits more easily, making the use of bundling more effective.

The message of this paper is that deregulation can increase the strategic incentive to use bundling as a mechanism to deter entry. Our results confirm that consumers' valuations are crucial in understanding the incentives of a monopolist to use bundling as an entry-deterrence tool after a shopping-hour deregulation. We show that, for a range of parameters, the market will change from an independent pricing regime, when shopping hours are regulated, to a monopoly regime, when shopping hours are deregulated. For the rest of the range of parameters, market structure does not change after deregulation and there is an improvement in social welfare.

The paper is organized as follows. In describing the model in the next section, we distinguish in Sections 3 and 4 between the cases where there is shopping-hour deregulation and the case where there is regulation. Section 5 analyzes welfare implications and Section 6 concludes the paper.

2. The model

There are two independent markets, A and B, and two sellers, 1 and 2.[6] Market A is monopolized by seller 1 and market B is potentially served by both sellers, seller 1 and seller 2. The products of seller 1 and seller 2 in market B are horizontally differentiated. Consumers are heterogeneous with respect to their most preferred variety of product B and time of shopping. We assume there is a continuum of consumers uniformly distributed with density one in $S=[0,1]\times[0,1]$. A consumer located at $(x,t)\in S$ has the location x as the preferred variety of product B and the time t is the preferred shopping hour.

Let Bi denote seller i's variety of product B, for $i=1,2$. We assume that $B1$ is located at $x=0$ and $B2$ is located at $x=1$. Moreover, each seller decides between opening or not opening. Production in both markets involves set-up costs of K, and variable costs of c_A and c_B in markets A and B, respectively. We assume without loss of generality that $c_A=c_B=0$. Finally, seller 1 is able to commit to tying products A and B before setting prices.

Each consumer desires at most one unit of product A and one unit of product B. We assume a reservation price of $C>0$ for product A and a valuation of $v_{Bi}(x,t)=C-\lambda\cdot dist_i(x)-\lambda\cdot dist_i(t)$ for product Bi. The term $dist_i(x)$ is the distance between the consumer's ideal variety and product Bi, i.e., $dist_1(x)=x$ and $dist_2(x)=1-x$. Moreover, consumers incur a disutility of $\lambda\cdot dist_i(t)$ when their ideal shopping hour does not coincide with the time interval during which seller i is open.

[6] We consider there are no complementarities in creating the bundle, either in consumption or in production. Thus, on the consumption side, the value of both products together is equal to the sum of its values alone. Similarly, on the production side, the cost of both products together is equal to the sum of its values alone.

In the absence of bundling by seller 1, consumers respond to $\left(p_A, p_{B1}, p_{B2}\right)$. It is easy to prove that when bundling is not permitted, then firm 1 always sets $p_A = C$. When seller 1 commits to tying, consumers respond to $\left(p, p_{B2}\right)$ where p is the price of the bundle.

We analyze a three-stage game. In the first stage of the game, seller 1 commits to which of the two situations possible it will be able to produce–to produce products A and $B1$ separately, or to produce only a bundle. In the second stage, each seller simultaneously decides whether to open in market B. If seller i decides to be active, it incurs the set-up cost K. Finally, both sellers set prices (simultaneously and non-cooperatively if both are active).[7]

The main point of this paper is to show that the monopolist is afforded a strategy change with respect to the bundling decision under shopping-hour deregulation. We analyze two market situations: a regulated and a deregulated market. Firstly, we consider a deregulated market where sellers open during the whole time interval $\left[0,1\right]$. In this case, consumers do not incur time disutility because they can buy at their ideal shopping hour, i.e., $dist_i\left(t\right)=0$. In this case, we have just to deal with a one-dimensional problem. Secondly, we consider a regulated market where sellers open during the time interval $\left[0,1/2\right]$. Hence, half the consumers can buy at their ideal shopping hour, whereas the rest incur time disutility. In this case, we have to deal with a two-dimensional problem with time and product differentiation. All those consumers whose ideal shopping hour is at $t\in\left[1/2,1\right]$ incur a time disutility of $dist_i\left(t\right)=t-1/2$. This means that consumers whose preferred shopping time lies outside the shopping hours buy at the last moment ($t=1/2$). The rest of them ($t\in\left[0,1/2\right]$) do not incur time disutility.[8]

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[7] Seller 1 could choose to produce seven different sets of products: both products separately, both products separately and also a bundle, etc. However, Whinston (1990) proves that we can restrict our attention to the two different sets of products we consider in the game.

[8] This time structure captures the idea that some consumers can make their work or leisure time compatible with the shopping hour. However, it is more difficult for other consumers to make them compatible, who have to incur some cost (in terms of disutility) when solving this incompatibility. We also allow for different compatibility costs within this set of inconvenienced consumers, since the reasons for their time schedule incompatibility could be different.

Figure 1 illustrates consumers' distribution. The X-axis shows product B's varieties where seller 1's product $B1$ is at $x=0$ and seller 2's product $B2$ is at $x=1$. The Y-axis shows the time interval. Consumers in the shaded area do not incur time disutility because they can always go shopping at their preferred shopping time, whereas the rest of the consumers incur a time disutility of $dist_i(t)=t-1/2$ when the shopping hour is regulated.

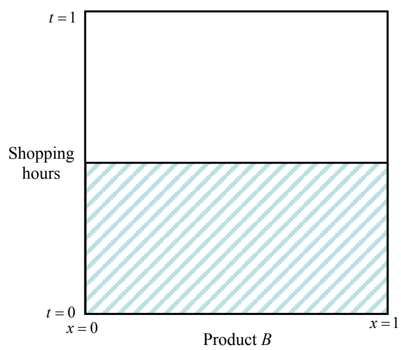


Figure 1. Consumers distribution.

3. The deregulated market

Deregulation of shopping time allows consumers to buy at their ideal shopping hour. We start the analysis with the liberalized market because this is the simplest case. In this case there is no time dimension. As usual, we proceed to solve the three stage game by backward induction. We first calculate the equilibrium prices.[9]

3.1. Equilibrium prices

Both sellers open and there is independent pricing

In this section, we assume seller 1 commits not to bundle products A and B and consumers can buy at their preferred shopping time. Figure 2 shows the division of

[9] Although in a different context, we follow the same steps used by Matutes and Regibeau (1988) to solve the game. The authors analyzed the problem of "mix and match" with firms' compatibility decisions.

sellers' market B. There are several cases, depending on the level of the reservation price C relative to the product differentiation parameter λ.

We assume first that the whole market is served. A consumer located at (x,t) will purchase product B from seller 1 rather than from seller 2 if $\lambda x + p_{B1} \leq \lambda(1-x) + p_{B2}$. Consumers do not incur a disutility in the time dimension. Accordingly, consumers indifferent between shopping at seller 1 or 2 are located on the line $\tilde{x} = 1/2 + (p_{B2} - p_{B1})/2\lambda$. Thus, sellers' profits are $\pi_1 = C + p_{B1}\tilde{x} - K$ and $\pi_2 = p_{B2}(1-\tilde{x}) - K$. Maximizing profits with respect to p_{B1} and p_{B2}, respectively, yields the equilibrium prices

$$p_A^* = C\,,\ p_{Bi}^* = \lambda\,. \tag{1}$$

and thus, the demand and profits are

$$d_i^* = \tilde{x}_i^* = 1/2\,,\ \pi_1^* = C + \lambda/2 - K \text{ and } \pi_2^* = \lambda/2 - K\,. \tag{2}$$

This is a valid solution so long as the whole market is indeed served at equilibrium prices, i.e., so long as consumers at $x = 1/2$ satisfy $C - \lambda/2 - p_{Bi}^* \geq 0$, or $C \geq 3\lambda/2$. Consumer surplus is

$$CS^* = 2\int_0^{1/2}\int_0^1 \left(C - \lambda x - p_{B1}^*\right)dxdt = C - 5\lambda/4\,, \tag{3}$$

and social welfare is $W^* = CS^* + \pi_1^* + \pi_2^* = 2C - \lambda/4 - 2K$.

If $C \leq 3\lambda/2$, the whole market is not served at the equilibrium prices just derived. These are two cases. For low reservation prices the sellers will behave as local monopolists, with seller 1 serving all the consumers such that $C - \lambda x - p_{B1} \geq 0$. Maximizing $\pi_1 = C + p_{B1}(C - p_{B1})/\lambda - K$ and $\pi_2 = p_{B2}(C - p_{B2})/\lambda - K$ with respect to p_{B1} and p_{B2}, respectively, yields $p_A^* = C$, $p_{Bi}^* = C/2$, $d_i^* = C/2\lambda$, $\pi_1^* = C + C^2/4\lambda - K$ and $\pi_2^* = C^2/4\lambda - K$. This is a valid solution if the sellers' markets do not overlap at the equilibrium prices, i.e., if consumers at $x = 1/2$ satisfy $C - \lambda/2 - C/2 \leq 0$, or $C \leq \lambda$.

For $\lambda \leq C \leq 3\lambda/2$, the sellers engage in limit pricing in the sense that each seller sets its price so that its market just touches the other seller's market, (i.e., consumer surplus is zero on the market boundary, $C-\lambda/2-p_{Bi}=0$). This implies that $p_A^*=C$, $p_{Bi}^*=C-\lambda/2$, $d_i^*=1/2$, $\pi_1^*=3C/2-\lambda/4-K$ and $\pi_2^*=C/2-\lambda/4-K$.

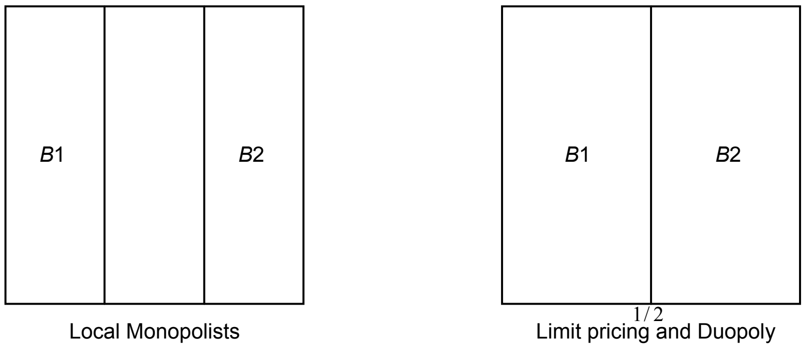


Figure 2. Sellers' product B markets with independent pricing under deregulation.

Both sellers open and seller 1 commits to bundle both products

We now assume that both sellers open and seller 1 commits to bundle both products. As in the previous section, there are several cases to be considered, depending on the level of the reservation price C relative to the product differentiation parameter λ. Figure 3 shows the division of sellers' market B.

We assume first that the whole market is served. A consumer located at (x,t) will purchase product B from seller 1 rather than from seller 2 if $2C-\lambda x-p\leq C-\lambda(1-x)-p_{B2}$. An important property is that under bundling, if we define the fictitious price $\overline{p}_{B1}\equiv p-C$, we obtain the inequality $C-\lambda x-\overline{p}_{B1}\leq C-\lambda(1-x)-p_{B2}$, which is the same condition as with independent pricing in the previous section. Note that everything is as if bundling increased seller 1's price in market B by C.

Consumers do not incur time disutility. Accordingly, consumers indifferent between shopping at seller 1 or 2 are located on the line $\tilde{x}=1/2+(p_{B2}-\overline{p}_{B1})/2\lambda$. Thus, sellers profits are $\pi_1=(\overline{p}_{B1}+C)\tilde{x}-K$ and $\pi_2=p_{B2}(1-\tilde{x})-K$. Maximizing profits with respect to $\overline{p}_{B1}$ and p_{B2}, respectively, yields the equilibrium prices

$$\overline{p}_{B1}^* = \lambda - 2C/3 \text{ and } p_{B2}^* = \lambda - C/3. \quad (4)$$

Thus, the bundle price is $p^* = \lambda + C/3$ and demands and profits are

$$d_1^* = 1/2 + C/6\lambda,\ d_2^* = 1 - d_1^*,\ \pi_1^* = (3\lambda + C)^2/18\lambda - K \text{ and } \pi_2^* = (3\lambda - C)^2/18\lambda - K. \quad (5)$$

This is a valid solution so long as the whole market is indeed served at equilibrium prices, i.e., so long as $C - \lambda\tilde{x}^* - \overline{p}_{B1}^* \geq 0$, or $C \geq \lambda$, and so long as $\tilde{x}^* \leq 1$, or $C \leq 3\lambda$. Note that for $C = \lambda$ and $C = 3\lambda$, we have that $d_1^* = 2/3$ and $d_1^* = 1$, respectively. For $C \geq 3\lambda$, seller 1 monopolizes the market of product B. This situation is solved in the next section

If $C < \lambda$, the whole market is not served at the equilibrium prices just derived. These are two cases. For low reservation prices the sellers will behave as local monopolists, with seller 1 serving all the consumers such that $C - \lambda x - \overline{p}_{B1} \geq 0$ and seller 2 serving all the consumers such that $C - \lambda(1-x) - p_{B2} \geq 0$. Maximizing $\pi_1 = (\overline{p}_{B1} + C)(C - \overline{p}_{B1})/\lambda - K$ and $\pi_2 = p_{B2}(C - p_{B2})/\lambda - K$ with respect to $\overline{p}_{B1}$ and p_{B2}, respectively, yields, $\overline{p}_{B1}^* = 0$, $p_{B2}^* = C/2$, $p^* = C$, $d_1^* = C/\lambda$, $d_2^* = C/2\lambda$, $\pi_1^* = C^2/\lambda - K$ and $\pi_2^* = C^2/4\lambda - K$. This is a valid solution if the sellers' markets do not overlap at the equilibrium prices, i.e., if $C - 2\lambda/3 \leq 0$, or $C \leq 2\lambda/3$. Note that if $C = 2\lambda/3$ then $d_1^* = 2/3$ and $d_2^* = 1/3$.

For $2\lambda/3 \leq C \leq \lambda$, the sellers engage in limit pricing in the sense that each seller sets its price so that its market just touches the other seller's market, (i.e., consumer surplus is zero on the market boundary $C - 2\lambda/3 - \overline{p}_{B1} = 0$ and $C - \lambda/3 - p_{B2} = 0$). This implies that, $\overline{p}_{B1}^* = C - 2\lambda/3$, $p_{B2}^* = C - \lambda/3$, $p^* = 2C - 2\lambda/3$, $d_1^* = 2/3$, $d_2^* = 1/3$, $\pi_1^* = 4C/3 - 4\lambda/9 - K$ and $\pi_2^* = C/3 - \lambda/9 - K$.

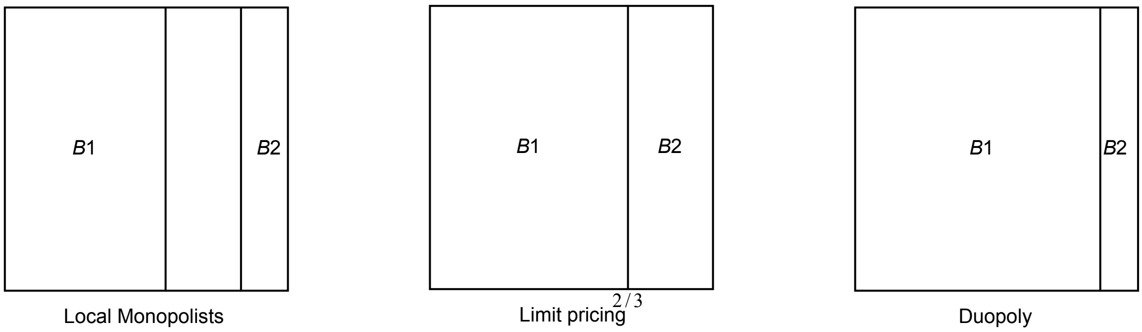


Figure 3. Sellers' product B markets with bundling strategy under deregulation.

Seller 2 does not open and seller 1 commits to bundle both products

In this section we consider the case where seller 2 does not enter and, thus, seller 1 monopolizes the market of product B. A consumer located at (x,t) will purchase the bundle from seller 1 if $C-\lambda x-\overline{p}_{B1}\geq 0$. Consequently, consumers indifferent between shopping at seller 1 or not shopping are located on the line $\tilde{x}=\left(C-\overline{p}_{B1}\right)/\lambda$. Thus, seller 1's profits are

$$\pi_1=\begin{cases}\overline{p}_{B1}+C-K & \text{for } \overline{p}_{B1}\leq C-\lambda\\ \left(\overline{p}_{B1}+C\right)\left[\left(C-\overline{p}_{B1}\right)/\lambda\right]-K & \text{for } C-\lambda\leq \overline{p}_{B1}\leq C\\ -K & \text{for } C\leq \overline{p}_{B1}\end{cases}\qquad(6)$$

Maximizing profits with respect to $\overline{p}_{B1}$ yields the following equilibrium prices. For $C\leq\lambda$, the equilibrium prices are $\overline{p}_{B1}^{*}=0$ and $p^{*}=C$, and the demand and profits are $d_1^{*}=C/\lambda$ and $\pi_1^{*}=C^2/\lambda-K$. If $C\geq\lambda$, the equilibrium prices are $\overline{p}_{B1}^{*}=C-\lambda$ and $p^{*}=2C-\lambda$, and the demand and profits are $d_1^{*}=1$ and $\pi_1^{*}=2C-\lambda-K$.

3.2. Equilibrium of the game

Before we look at the other stages of the game, we point out some properties of the equilibrium outcome derived above. Note that the following results come directly from the expression already obtained in the previous section.

Lemma 1. Seller 1's optimal effective price for good B is lower under bundling than under independent good pricing.

Lemma 1 shows that a bundling strategy increases competition in market B. Since those consumers that buy product B from seller 2 do not buy either products A and B from seller 1, seller 1 responds with a price reduction of the bundle to minimize the demand losses in product A's market.

Lemma 2. In the subgame where both sellers are open and seller 1 has committed itself to produce only the bundle, both sellers earn less than they do in the independent pricing game.

From Lemma 2 we have that, when sellers are active, profits with bundling are lower than with independent pricing. This result comes directly from Lemma 1 and the main consequence of it is that seller 1 would never commit to bundling unless this would succeed in driving seller 2 out of the market.

Lemma 3. In the subgame where both sellers are open, seller 1's profits are greater than seller 2's profits.

The main conclusion derived from above lemmas is that there are only two possible equilibrium outcomes in this model: duopoly with independent pricing or monopoly with a bundle of products. Next, we characterize both results in terms of the parameters of the model. Let us now define the equilibrium seller i's profits as π_{iB}^{*} in the subgame where both sellers are open and seller 1 has committed itself to produce only the bundle, and π_{iI}^{*} are the profits earned in the subgame where both sellers are open and there is independent product pricing. Finally, let π_{1M}^{*} be the seller 1's monopoly profits in the subgame where it produces the bundle (see Table 1). From **Lemma 2** and **Lemma 3**, we derive the following result.

Lemma 4. If both sellers are open then $\pi_{2B}^{*} < \min\left\{\pi_{1B}^{*}, \pi_{1I}^{*}, \pi_{2I}^{*}\right\}$.

From Lemma 4 we have that, when both sellers are active, the worst profits are those obtained by seller 2 under a bundle regime. This implies that the easiest way for seller 1 to deter entry is through bundling both products.

We are interested in analyzing the equilibrium outcome when seller 1 uses bundling to restrict entry. Let $K_{C,\lambda}$ be the set-up cost for which seller 2 has no gains under a bundling regime, i.e., $\pi_{2B}^{*}=0$. Clearly, the expression of $K_{C,\lambda}$ depends on the consumers' reservation price C and the disutility parameter λ. From Lemma 4 we have that this is the maximum cost at which both sellers are operative under either regime: bundling and independent pricing. Let us now consider the set composed of all set-up costs at which seller 1 is operative under either regime and seller 2 is always operative under an independent pricing regime, i.e., $\Omega=\left\{K\ /\min\left\{\pi_{1B}^{*},\pi_{1I}^{*},\pi_{2I}^{*}\right\}>0\right\}$.[10]

Note that $K_{C,\lambda}\in\Omega$. Hence, for $K\in\Omega$, if the set-up cost is sufficiently low, i.e., $K<K_{C\lambda}$, seller 1 cannot deter entry and the solution of the game is independent product pricing. Otherwise, although bundling would drive seller 2 out of the market, seller 1 may or may not find it profitable to do so. In this latter situation, we then obtain the two possible solutions. So long as monopoly profits are greater than duopoly profits, i.e., $\pi_{1M}^{*}>\pi_{1I}^{*}$, the best strategy for seller 1 is to bundle both products and deter the entry of seller 2. Otherwise, so long as $\pi_{1M}^{*}<\pi_{1I}^{*}$, seller 1 does not bundle products and seller 2 enters into the market of product B. Thus, we can conclude that there is entry deterrence for $K>K_{C\lambda}$ and $\pi_{1M}^{*}>\pi_{1I}^{*}$. The intuition behind this result relies on consumer heterogeneity. Seller 1 does not gain from converting market B from duopoly into a monopoly when there are many consumers who strongly dislike product $B1$, i.e., when products are sufficiently differentiated. It is in this point where deregulation can play a significant role.

If we compute the expression of $K_{C,\lambda}$ by using the equilibrium outcome already obtained in the previous section, we can state the following result.

[10] We exclude all situations that force the exit of seller 1. If product A is very profitable, however, this effect is unlikely to occur.

Proposition 1. In the situation where shopping hours are not regulated, the solution of the game is

a) For $C < 3\lambda/2$, both sellers open and there is independent product pricing.

b) For $3\lambda/2 < C < 3\lambda$, if $K < (3\lambda - C)^2/18\lambda$ then both sellers open and there is independent product pricing. On the contrary, seller 1 bundles both products and seller 2 does not open.

c) For $C > 3\lambda$, seller 1 opens and bundles both product whereas seller 2 does not open.

Proposition 1 says that seller 1 uses bundling to restrict entry for high enough reservation price ($C > 3\lambda$) or for intermediate reservation price combined with high enough fixed cost ($3\lambda/2 < C < 3\lambda$ and $K > (3\lambda - C)^2/18\lambda$). The consumer surplus and social welfare in the independent pricing solution is greater than under the bundling solution.

<table>
<tr><th></th><th colspan="3">Deregulated market</th></tr>
<tr><th></th><th>Not Bundle/Both Open</th><th>Bundle/Both Open</th><th>Bundle/Monopoly</th></tr>
<tr><td>$0 < C < 2\lambda/3$</td><td rowspan="2">$\pi_1^* = C + C^2/4\lambda - K$
$\pi_2^* = C^2/4\lambda - K$</td><td>$\pi_1^* = C^2/\lambda - K$
$\pi_2^* = C^2/4\lambda - K$</td><td>$\pi_1^* = C^2/\lambda - K$
$\pi_2^* = 0$</td></tr>
<tr><td>$2\lambda/3 < C < \lambda$</td><td>$\pi_1^* = 4C/3 - 4\lambda/9 - K$
$\pi_2^* = C/3 - \lambda/9 - K$</td><td>$\pi_1^* = C^2/\lambda - K$
$\pi_2^* = 0$</td></tr>
<tr><td>$\lambda < C < 3\lambda/2$</td><td>$\pi_1^* = 3C/2 - \lambda/4 - K$
$\pi_2^* = C/2 - \lambda/4 - K$</td><td rowspan="3">$\pi_1^* = (3\lambda + C)^2/18\lambda - K$
$\pi_2^* = (3\lambda - C)^2/18\lambda - K$</td><td rowspan="4">$\pi_1^* = 2C - \lambda - K$
$\pi_2^* = 0$</td></tr>
<tr><td>$3\lambda/2 < C < 2\lambda$</td><td rowspan="3">$\pi_1^* = C + \lambda/2 - K$
$\pi_2^* = \lambda/2 - K$</td></tr>
<tr><td>$2\lambda < C < 3\lambda$</td></tr>
<tr><td>$3\lambda < C$</td><td>$\pi_1^* = 2C - \lambda - K$
$\pi_2^* = 0$</td></tr>
</table>

Table 1. Equilibrium profits under shopping-hour deregulation.

4. The regulated market

A regulated market implies that half the consumers can buy at their preferred shopping time whereas the rest of consumers do not and they must incur a time disutility. Thus, we have to deal with a two-dimensional problem where, to the disutility motivated by not doing shopping at the ideal time, consumers also suffer the disutility caused by not buying their preferred variety of product B.

The procedure for solving this game is similar to the one in the deregulated market. The main difference is in that there is an increase in consumer heterogeneity. Those consumers with a high valuation for a deregulated shopping time (with t close to 1) now have a low valuation for product B. Since sellers cannot discriminate between consumers, it is more difficult for them to extract the consumer surplus than in a deregulated market. This makes the expression of the equilibrium outcome a little complicated.

4.1. Equilibrium prices

Both sellers open and there is independent pricing

In this section, we assume that both sellers open during $t \in [0,1/2]$ and seller 1 does not bundle both products. Figure 4 shows the division of sellers' markets of product B. We assume first that the whole market is served. A consumer located at (x,t) will purchase product B from seller 1 rather than from seller 2 if

$$\lambda x + \lambda dist_1(t) + p_{B1} \leq \lambda(1-x) + \lambda dist_2(t) + p_{B2}. \qquad (7)$$

Consumers with $t \in [0,1/2]$ buy at their preferred moment in time and do not incur a disutility in the time dimension. Accordingly, consumers indifferent between shopping to seller 1 or 2 are located on the line

$$\tilde{x} = 1/2 + (p_{B2} - p_{B1})/2\lambda. \qquad (8)$$

Next consider consumers with $t \in [1/2,1]$. In order to minimize the disutility incurred with respect to the time dimension they buy at $t = 1/2$ (sellers' closing time) and incur a disutility equal to $\lambda(t-1/2)$ independently of whether they shop at seller 1 or 2, i.e., $dist_1(t) = dist_2(t)$. The term $dist_i(t)$ cancels out on both sides of (7) so that we obtain indifferent consumer location as in (8).

We obtain the same indifferent consumers as in the deregulated case and, thus, the equilibrium prices, demand and profits are as in (1) and (2). This is a valid solution so long as the whole market is indeed served at equilibrium prices, i.e., so long as the consumer at $(x,t)=(1/2,1)$ buys the product B, i.e., $C-\lambda/2-\lambda/2-p_{Bi}^{*}\geq 0$, or $C\geq 2\lambda$. The consumer surplus is

$$CS=2\int_{0}^{1/2}\int_{0}^{1}\left(C-\lambda x-\lambda dist_{1}(t)-p_{B1}^{*}\right)dxdt=C-11\lambda/8 \qquad (9)$$

and social welfare is $W^{*.}=2C-3\lambda/8-2K$.

If $C\leq 2\lambda$, the whole market is not served at the equilibrium prices just derived. These are three cases. When the sellers do not serve the whole market but there is market overlap, sellers' profits are $\pi_{1}=C+p_{B1}\left(\tilde{x}-\left(2\lambda-2C+p_{B1}+p_{B2}\right)^{2}/8\lambda^{2}\right)-K$ and $\pi_{2}=p_{B2}\left(1-\tilde{x}-\left(2\lambda-2C+p_{B1}+p_{B2}\right)^{2}/8\lambda^{2}\right)-K$. Maximizing profits with respect to p_{B1} and p_{B2}, respectively, yields the equilibrium prices $p_{A}^{*}=C$ and $p_{Bi}^{*}=C/2$. Thus, the demand and profits are $d_{i}^{*}=C(4\lambda-C)/8\lambda^{2}$, $\pi_{1}^{*}=C+C^{2}(4\lambda-C)/16\lambda^{2}-K$ and $\pi_{2}^{*}=C^{2}(4\lambda-C)/16\lambda^{2}-K$. This is a valid solution so long as the consumer at $(x,t)=(1/2,1/2)$ buys the product B, i.e., so long as $C-\lambda/2-C/2\geq 0$, or $C\geq\lambda$. Note that for $C=\lambda$, we have that $d_{i}^{*}=3/8$.

For low reservation prices the sellers will behave as local monopolists, with seller 1 serving all the consumers such that $C-\lambda x-\lambda dist_{1}(t)-p_{B1}\geq 0$. Maximizing $\pi_{1}=C+p_{B1}\left[1+\left(C-p_{B1}\right)/\lambda\right]\left(C-p_{B1}\right)/2\lambda-K$ and $\pi_{2}=p_{B2}\left[1+\left(C-p_{B2}\right)/\lambda\right]\left(C-p_{B2}\right)/2\lambda-K$ with respect to p_{B1} and p_{B2}, respectively, yields $p_{A}^{*}=C$, $p_{Bi}^{*}=\left(\lambda+2C-\sqrt{\lambda^{2}+\lambda C+C^{2}}\right)/3$, $d_{i}^{*}=\left(-\lambda^{2}+2\lambda c+2c^{2}+(\lambda+2c)\sqrt{\lambda^{2}+\lambda c+c^{2}}\right)/18\lambda^{2}$, $\pi_{1}^{*}=C+\left(-2\lambda^{3}-3\lambda^{2}C+3\lambda C^{2}+2C^{2}+2\left(\lambda^{2}+\lambda C+C^{2}\right)^{3/2}\right)/54\lambda^{2}-K$ and

$\pi_2^* = \left(-2\lambda^3 - 3\lambda^2 C + 3\lambda C^2 + 2C^2 + 2\left(\lambda^2 + \lambda C + C^2\right)^{3/2}\right)/54\lambda^2 - K$. This is a valid solution if the sellers' markets do not overlap at the equilibrium prices, i.e., if consumer at $(x,t) = (1/2, 0)$ satisfies $C - \lambda/2 - p_{B1}^* \le 0$, or $C \le 7\lambda/8$. Note that for $C = 7\lambda/8$, we have that $d_i^* = 3/8$.

Finally, for $7\lambda/8 \le C \le \lambda$, the sellers engage in limit pricing in the sense that each seller sets its price so that its market just touches the other seller's market, (i.e., consumer surplus is zero on the market boundary, $C - \lambda/2 - p_{Bi} = 0$). This implies that $p_A^* = C$, $p_{Bi}^* = C - \lambda/2$, $d^* = 3/8$, $\pi_1^* = 11C/8 - 3\lambda/16 - K$ and $\pi_2^* = 3C/8 - 3\lambda/16 - K$.

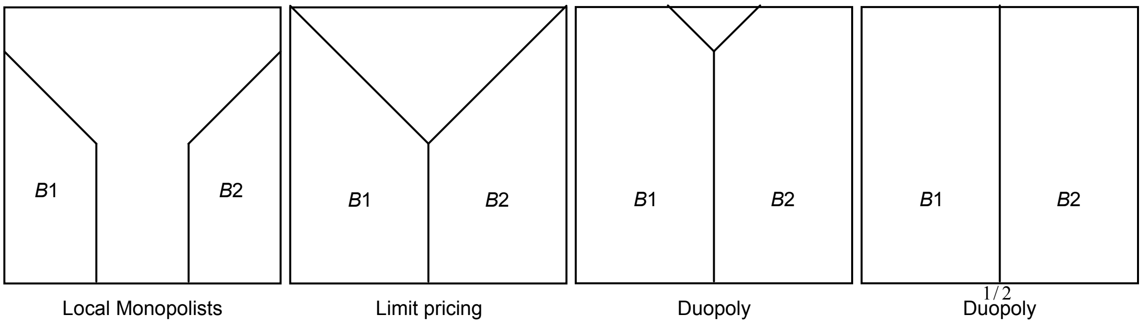


Figure 4. Sellers' product B markets with independent pricing under regulation.

Both sellers open and seller 1 commits to bundle both products

Let us consider the case where seller 1 bundles both products and the two sellers sell during $t \in [0, 1/2]$. We assume first that the whole market is served. A consumer located at (x,t) will purchase the bundle from seller 1 rather than the product B from seller 2 if

$$C - \lambda x - \lambda dist_1(t) - \overline{p}_{B1} \ge C - \lambda(1-x) - \lambda dist_2(t) - p_{B2}. \quad (10)$$

Let us define the fictitious price $\overline{p}_{B1} \equiv p - C$ as in the deregulated case. Thus, condition (10) changes to $\lambda x + \lambda dist_1(t) + \overline{p}_{B1} \le \lambda(1-x) + \lambda dist_2(t) + p_{B2}$, which is the same condition as with not bundling in the previous section. The different divisions of sellers' markets are depicted in Figure 5.

Consumers with $t \in [0, 1/2]$ buy at their preferred moment in time and do not incur a disutility in the time dimension. Accordingly, consumers indifferent between shopping to seller 1 or 2 are located on the line

$$\tilde{x} = 1/2 + \left(p_{B2} - \overline{p}_{B1}\right)/2\lambda. \qquad (11)$$

Next consider consumers with $t \in [1/2, 1]$. In order to minimize the disutility incurred with respect to the time dimension they buy at $t = 1/2$ and incur a disutility equal to $\lambda(t - 1/2)$ independently of whether they shop at seller 1 or 2, i.e., $dist_1(t) = dist_2(t)$. The $dist_i(t)$ term cancels out on both sides of (10) so that we obtain an indifferent consumer location as in (11). We obtain the same indifferent consumers as in the deregulated case and, thus, the equilibrium prices, demands and profits are as in (4) and (5). This is a valid solution so long as the whole market is indeed served at equilibrium prices, i.e., so long as $C - \lambda\tilde{x}^* - \lambda/2 - \overline{p}_{B1}^* \geq 0$, or $C \geq 4\lambda/3$, and $\tilde{x}^* \leq 1$, or so long as $C \leq 3\lambda$. Note that for $C = 4\lambda/3$ and $C = 3\lambda$, we have that $d_1^* = 13/18$ and $d_1^* = 1$, respectively. For $C \geq 3\lambda$, seller 1 monopolizes the market of product B. This situation is solved in the next section.

If $C \leq 4\lambda/3$, the whole market is not served at the equilibrium prices just derived. When the sellers do not serve the whole market but there is market overlap, sellers' profits are $\pi_1 = \left(\overline{p}_{B1} + C\right)\left(\tilde{x} - \left(2\lambda - 2C + \overline{p}_{B1} + p_{B2}\right)^2/8\lambda^2\right) - K$ and $\pi_2 = p_{B2}\left(1 - \tilde{x} - \left(2\lambda - 2C + \overline{p}_{B1} + p_{B2}\right)^2/8\lambda^2\right) - K$. Maximizing profits with respect to $\overline{p}_{B1}$ and p_{B2}, respectively, yields the equilibrium prices $\overline{p}_{B1}^* = \dfrac{3C^2}{4(16\lambda - 3C)}$, $p_{B2}^* = \dfrac{(32\lambda - 9C)C}{4(16\lambda - 3C)}$, $p^* = C + \overline{p}_{B1}^*$, and thus, the demand and profits $d_1^* = \dfrac{(64\lambda - 9C)(8\lambda - 3C)C}{32\lambda^2(16\lambda - 3C)}$, $d_2^* = \dfrac{(32\lambda - 9C)(8\lambda - 3C)C}{32\lambda^2(16\lambda - 3C)}$, $\pi_1^* = \dfrac{(64\lambda - 9C)^2(8\lambda - 3C)C^2}{128\lambda^2(16\lambda - 3C)^2} - K$ and $\pi_2^* = \dfrac{(32\lambda - 9C)^2(8\lambda - 3C)C^2}{128\lambda^2(16\lambda - 3C)^2} - K$. This is a valid solution so long as the consumer at $(x,t)=(1,1)$ buys the product B, i.e., so long as $C-\lambda/2-p_{B2}^{*}\geq 0$, or $C\geq\lambda$.

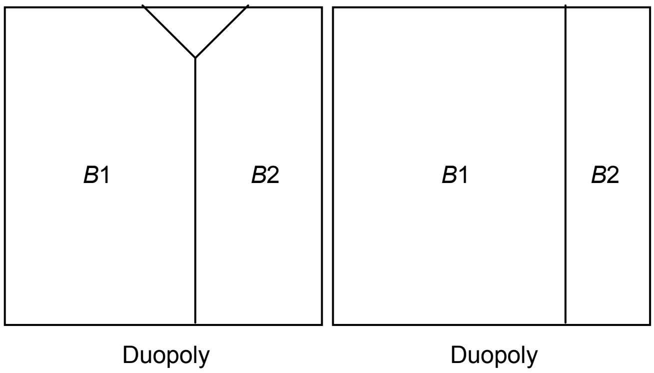


Figure 5. Sellers' product B markets with bundling strategy under regulation.

Seller 2 does not open and seller 1 commits to bundle both products

When seller 1 opens during $t\in[0,1/2]$ and seller 2 does not open. A consumer located at (x,t) will purchase the bundle from seller 1 if $C-\lambda x-\lambda dist_1(t)-\overline{p}_{B1}\geq 0$. If the consumer prefers shopping at $t\in[1/2,1]$, then she incurs a time disutility of $dist_1(t)=\lambda(t-1/2)$. Accordingly, consumers indifferent between buying the bundle or not buying are located on the line $x=(C-\overline{p}_{B1})/\lambda$, for $t\in[0,1/2]$ and $x=(C-\lambda(t-1/2)-\overline{p}_{B1})/\lambda$, for $t\in[1/2,1]$. See, Figure 6.

Thus, seller 1's profits are

$$\pi_1=\begin{cases}\overline{p}_{B1}+C-K & \text{for } \overline{p}_{B1}<C-3\lambda/2\\ (\overline{p}_{B1}+C)\left[1-\left(3/2-(C-\overline{p}_{B1})/\lambda\right)^2/2\right]-K & \text{for } C-3\lambda/2<\overline{p}_{B1}<C-\lambda\\ (\overline{p}_{B1}+C)\left[(C-\overline{p}_{B1})/\lambda-1/8\right]-K & \text{for } C-\lambda<\overline{p}_{B1}<C-\lambda/2\\ (\overline{p}_{B1}+C)\left[(C-\overline{p}_{B1})\left(1+(C-\overline{p}_{B1})/\lambda\right)/2\lambda\right]-K & \text{for } C-\lambda/2<\overline{p}_{B1}<C\\ -K & \text{for } C<\overline{p}_{B1}\end{cases}$$

(12)

Maximizing profits with respect to $\overline{p}_{B1}$ yields the following equilibrium prices. For $C > 11\lambda/8$, the optimal price is in Zone A (see Figure 6) and it is given by $\overline{p}_{B1}^{*} = \left(-6\lambda + 2C + \sqrt{33\lambda^2 - 24\lambda C + 16C^2}\right)/6$. Thus the price of the bundle is given by $p^{*} = \left(-6\lambda + 8C + \sqrt{33\lambda^2 - 24\lambda C + 16C^2}\right)/6$. For $15\lambda/16 < C < 11\lambda/8$, the optimal prices are in Zone B and they are $\overline{p}_{B1}^{*} = C - \lambda$ and $p^{*} = 2C - \lambda$. For $7\lambda/16 < C < 15\lambda/16$, the optimal prices are in Zone C and they are given by $\overline{p}_{B1} = -\lambda/16$ and $p^{*} = C - \lambda/16$. Finally, if $C < 7\lambda/16$, the optimal prices are in Zone D and they are given by $\overline{p}_{B1}^{*} = (\lambda + C - \sqrt{\lambda^2 + 2\lambda + 4C^2})/3$ and $p^{*} = (\lambda + 4C - \sqrt{\lambda^2 + 2\lambda + 4C^2})/3$. By substituting these equilibrium prices in the profit function (12), we obtain the equilibrium profit of seller 1.

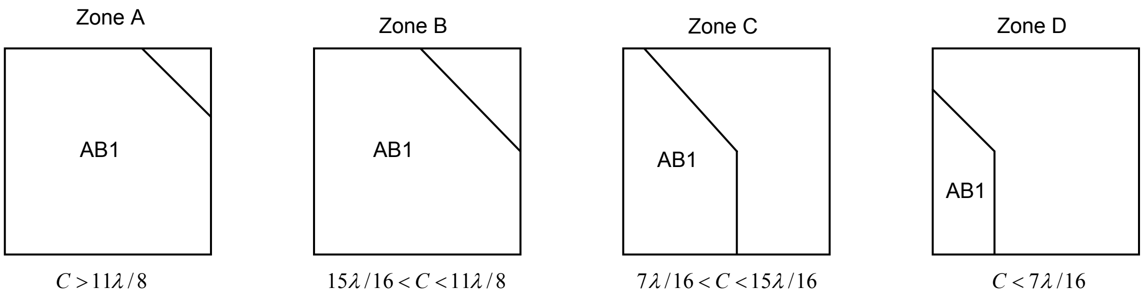


Figure 6. Seller 1's market under monopoly and bundling with regulation.

4.2. Equilibrium of the game

Proceeding as in the deregulated market, we find the following equilibrium outcome for the two stage game.

Proposition 2. In the situation where shopping hours are regulated, the solution of the game is

a) For $C \leq 1.7\lambda$, both sellers open and there is independent product pricing.
b) For $1.7\lambda \leq C \leq 3\lambda$, if $K < \left(3\lambda - C\right)^2/18\lambda$ then both sellers open and there is independent product pricing. On the contrary, seller 1 bundles both products and seller 2 does not open.

c) For $C \geq 3\lambda$, seller 1 opens and bundles both product whereas seller 2 does not open.

If we compare Proposition 1 and Proposition 2, we observe that they show similar results. Our interest is to compare both results and realize whether or not there is a change in the seller 1's strategy with respect to bundling under a shopping time deregulation.

5. Equilibrium outcome and welfare after deregulation

In this section, we analyze the differences between the equilibrium outcome under regulation and deregulation of shopping hours.

The reason why bundling would have an effect in this context is explained by Whinston (1990). In our model, as in Whinston (1990), bundling serves as a mechanism to take sales away from seller 2. The reason is because bundling commits seller 1 to sell to a consumer buying product A and also product B. This puts a consumer in the position to choose between buying either only product B from seller 2 or both products from seller 1. And from the perspective of seller 1 this implies that losing a consumer to the competitor reduces both the sales of products A and B. This makes the monopolist price product B more aggressively, which reduces the potential market share of the competitor. Thus, bundling commits seller 1 to being more aggressive toward the competitor, and this commitment may discourage entry.[11] This is the main effect that defines the equilibrium outcomes in each of both market regimes: regulation and deregulation of shopping hours. Next, we compare these two results.

We find two opposing effects of deregulation on the profitability of bundling. On the one hand, as consumers have a preferred hour to go shopping, deregulation of shopping hours may be viewed as a means to increase product valuation for consumers who have a higher preference for unrestricted shopping hours. These consumers do not incur time disutility with shopping-time deregulation. Both sellers' profits increase and it is more difficult to exclude the tying seller's rival by reducing the rival's profits. On the other

[11] Whinston (1990) calls this effect "strategic foreclosure".

hand, seller 1 has to charge all consumers one price. Under regulation, variability in consumers' valuations of shopping time frustrates seller's abilities to capture consumer surplus. Deregulation helps to reduce this heterogeneity and makes seller 1 earn greater monopoly profits more easily, making the use of bundling more effective. The crucial question now is which of the two effects will dominate.

To analyze the effects of shopping-time deregulation on the profitability of bundling strategy to deter entry, we have to distinguish between two cases: Case (i), $C \leq 1.5\lambda$ and $C \geq 1.7\lambda$ and, Case (ii), $C \in (1.5\lambda, 1.7\lambda)$. The equilibrium outcome shows that, in Case (i), there is no market structure change with shopping-hour deregulation. Interestingly, in Case (ii), we find the main result of the paper. For a sufficiently high set-up cost, $K > (3\lambda - C)^2 / 18\lambda$, there is a change in seller 1's optimal strategy. The optimal market structure changes from duopoly to monopoly (see Figure 7).

From Proposition 1 and Proposition 2 we have that, in Case (i), seller 1 does not change its strategy in relation to bundling. Independently of set-up costs, for a sufficiently small reservation price ($C < 1.5\lambda$), before and after deregulation seller 1 does not deter entry and there is independent pricing, whereas for high enough values of the reservation price ($C > 3\lambda$), seller 1 deters entry through bundling both products. To understand these results we have to focus on the duopoly profits obtained when seller 1 bundles both products. In the former case, the reservation price is so low that sellers act as a local monopolist. This fact makes it more difficult for seller 1 to deter entry through a strategic foreclosure. In the latter case, when the reservation price is so high, results show that the whole market is served. Seller 1, trying to capture the maximum number of sales, lowers the price of the bundle so much that the competitor practically loses all sales. It makes it impossible for seller 2 to be active. For $1.7\lambda < C < 3\lambda$, we find the independent pricing outcome for $K < (3\lambda - C)^2 / 18\lambda$ and the monopoly outcome for $K > (3\lambda - C)^2 / 18\lambda$.

Interestingly, in Case (ii), we do not find the previous outcome. For $K > (3\lambda - C)^2 / 18\lambda$, seller 1 finds it profitable to bundle both products and deter entry after deregulation while it was not under regulation. The intuition behind this result is that high set-up cost facilitates exclusion through bundling. Under regulation, this strategy is unprofitable because monopoly profits are lower than duopoly profits. However, deregulation reduces consumers' heterogeneity, increasing the monopoly profits. For sufficiently low fixed cost ($K < (3\lambda - C)^2 / 18\lambda$), market structure remains after deregulation. Both situations show an independent pricing regime. Seller 1 cannot deter entry and, therefore, the best strategy is to sell both products separately.

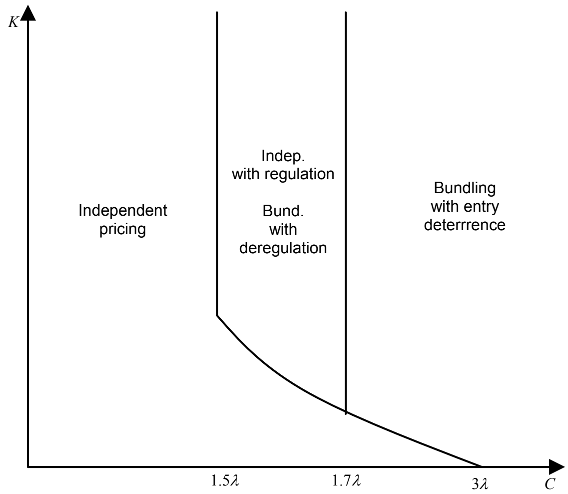


Figure 7. Equilibrium outcome.

The effect of deregulation on prices follows a similar pattern as with the market structure. For the range of parameters where market structure remains the same after deregulation, the results show what one expected. Deregulation of shopping hours maintains or increases prices (the equilibrium price of product B coincides for $2\lambda < C < 3\lambda$). The intuition behind this is that deregulation increases product valuation for those consumers who have higher preference for unrestricted shopping hours. Surprisingly, we have the opposite result when there is a change in the market structure. The equilibrium price with regulation is higher than under deregulation. Since, set-up costs are sufficiently high, foreclosure lowers the competitor's profits below the level that would justify continued operation. As we show, this bundling strategy is not profitable with regulation. However, after deregulation, seller 1 bundles both products and deters entry. Moreover, seller 1 sets a price sufficiently low in order to achieve the highest possible market share. Seller 1 market share after deregulation is practically the whole market whereas both sellers share consumers equally under regulation. This fact explains the price reduction.

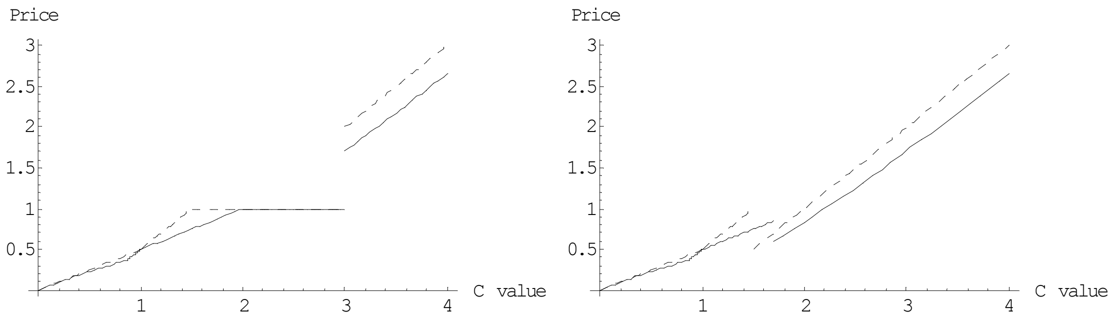
We find similar results for the consumer surplus and welfare. In Case (i), deregulation has two opposing effects on consumer surplus. As we explained before, on one hand, the prices charged by the sellers do not decrease (the equilibrium prices remain the same for $C \in (2\lambda, 3\lambda)$), but on the other, there is no restriction in shopping time so that consumers do not incur time disutility. If prices remain the same, consumers are either indifferent or unambiguously better off. For the range of parameters where the price increases, all consumers are not affected equally by deregulation. Consumers not affected by deregulation are worse off, since they buy at the same hour as with regulation but are charged a higher price. Consumers who, given the opportunity, would buy at their preferred hour are less clear. They now go shopping at their ideal hour, but they have to pay a higher price. The difference between the equilibrium prices with and without regulation will determine whether consumers will be better or worse off. If the gap between both prices is sufficiently large, the consumer surplus with deregulation will be lower than with regulation. This corresponds with the range of parameters where either it is profitable for seller 1 to deter entry through bundling products A and B, or both firms compete but there are some consumers who do not buy under restriction. In Case (ii), we obtain a similar result. Here, we must point out that for the range of parameters where there is a change in the market structure, the consumer surplus increases since there is a price reduction after deregulation

Finally, we show that for the range of parameters where there is no market change deregulation is always socially desirable. Social welfare is always higher after deregulation of shopping hours. We find the contrary result for the range of parameters where there is a change from an independent pricing regime to a monopoly regime after deregulation. Regulation is socially desirable. Although consumers are better off under deregulation because prices decrease, firms are worse off.

Numerical example

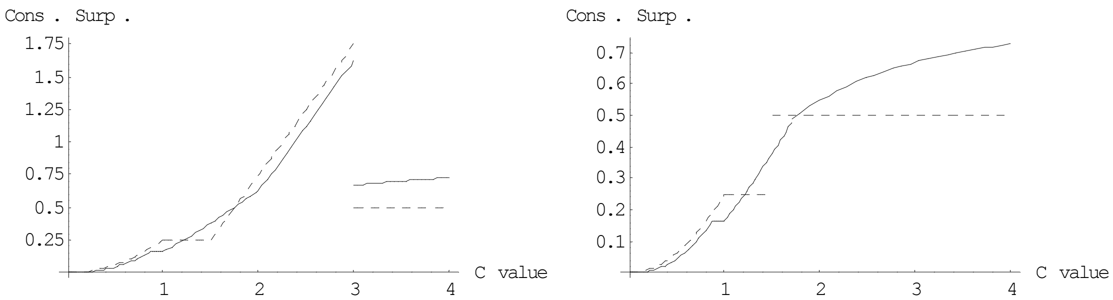
A particular numerical example may be helpful for illustration. Suppose that $\lambda = 1$, then we can plot the equilibrium outcomes with respect to C. We plot some representative variables. For each variable we show two graphics: Case (i) with low set-up costs

($K < \left(3\lambda - C\right)^2 / 18\lambda$) and Case (ii) with high set-up cost ($K > \left(3\lambda - C\right)^2 / 18\lambda$). In particular, figures 8, 9 and 10 show the equilibrium price of product B, the consumer surplus, and the welfare function, respectively. The dashed (solid) line represents the equilibrium outcome in the deregulated (regulated) market. If we pay attention to Case (ii), we observe that there is a discontinuity in the graph interval for $1.5\lambda < C < 1.7\lambda$, which corresponds to the situation where seller 1 changes the strategy with respect to bundling.



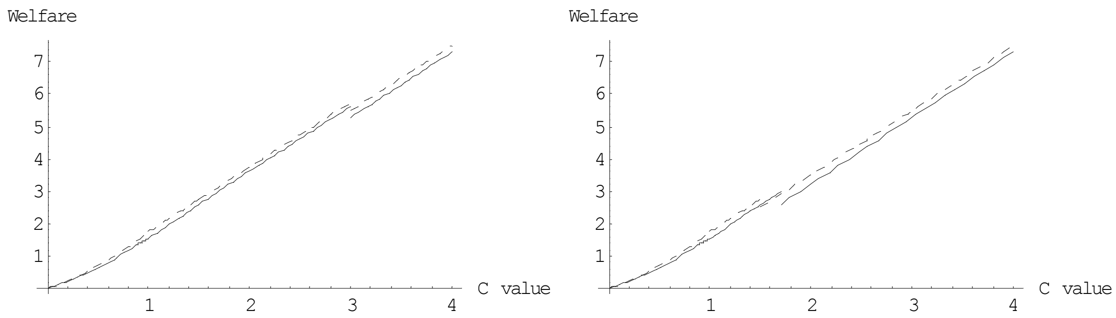
Case (i): $K < \left(3\lambda - C\right)^2 / 18\lambda$ Case (ii): $K > \left(3\lambda - C\right)^2 / 18\lambda$

Figure 8. Equilibrium prices for $\lambda = 1$.



Case (i): $K < \left(3\lambda - C\right)^2 / 18\lambda$ Case (ii): $K > \left(3\lambda - C\right)^2 / 18\lambda$

Figure 9. Consumer surplus for $\lambda = 1$.



Case (i): $K < (3\lambda - C)^2 / 18\lambda$ Case (ii): $K > (3\lambda - C)^2 / 18\lambda$

Figure 10. Welfare for $\lambda = 1$.

6. Conclusions

We have developed a model to analyze the effect of deregulation of opening hours on the strategic incentive to bundle products when bundling can serve as a tool of entry deterrence. We show that, for a range of parameters, bundling is an effective entry-deterrent strategy in response to deregulation. After regulation, a seller that has market power in two products can, by pre-committing to bundle them together, induce the exit of a rival seller that sells only one of these products. The market will change from an independent pricing regime when shopping hours are regulated, to a monopoly regime when shopping hours are deregulated. Furthermore, the equilibrium prices and social welfare with regulation are higher than with deregulation. However, consumers are worse off in the regulated context with a monopoly regime. For the rest of the range of the parameters, market structure does not change with deregulation and there is social welfare improvement. Finally, we conclude that deregulation tends to increase the range of parameters over which bundling is a profitable strategy.

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