EXCLUSIVITY CLAUSES AND BEST PRICE POLICIES IN INPUT MARKETS

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1. Introduction

It is well known that in order for the seller of a durable good to extract maximum rents from the market, the seller must be able to convince buyers that future action of the seller will not erode the value of the durable. For instance, an automobile company producing a limited-edition sports car must be able to convince potential buyers that it will not opportunistically increase the number of cars produced, once it has sold all of the units from the original production run. Similarly, a franchisor (such as the grantor of a distributorship or a supplier that grants to a marketing company the right to sell its product) must be able to convince the franchisee that no competing franchises will be established once the original franchisee has sunk nonrecoverable start-up costs. While auto companies have historically relied on reputation to convince buyers that the number of units produced will not be increased, franchisors have been able to use specific contractual clauses, which we will call exclusivity clauses, to commit to forgoing such future opportunistic behavior.¹

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¹ Typical examples of exclusivity clauses include granting a local electronics store that sells a particular brand of television the guarantee that no other store within a two-mile radius will be allowed to sell that brand of television, or granting a wholesale beer distributor the guarantee that no other distributor will be allowed to sell beer to any tavern located in the state of Wisconsin. See Section 2 for a more detailed description.
In this paper we will argue that while such exclusivity clauses may enable the seller of an input to extract all of the available rents from a downstream market when the supply and demand conditions in that market are constant over time, the use of such clauses will not allow the seller to extract all of the available rents when there is randomness in the market over which the seller and buyers cannot write enforceable contingent contracts. The main purpose of this paper is to show that when trying to sell an input in the presence of such noncontractable randomness, the seller can earn greater profits by employing most favored customer clauses (MFCs) than by using exclusivity clauses.

The literature that examines this problem in the context of a durable input begins with Bierman and Tollison (1970), who show that a monopolist who has access to a flow of future rents can capitalize the entire net present value of these rents only if monopoly power were guaranteed into the infinite (relevant) future. Applying this idea to franchises, Caves and Murphy (1976) argued informally that the seller of a franchise (the franchisor) must be able to limit her future actions in order to capture the rents from selling the franchise to downstream firms. The argument was that a franchisee would not be willing to pay the value of the monopoly rents that could be generated from owning the franchise because once he purchased the franchise, the franchisor could then opportunistically sell another franchise (at a lower price) to a competitor, which would destroy the franchisee’s monopoly position.

Blair and Kaserman (1982) provide a formal analysis of the problem identified by Caves and Murphy. They observe that a franchisor can sell a franchise right for a fixed fee (in order to avoid the well-known “double marginalization problem”) but then must offer exclusivity clauses such as territorial restrictions in order to prevent future opportunistic sales of additional franchises. Thus, the use of exclusivity clauses enables the franchisor to guarantee a franchisee a monopoly position in a downstream market, which would then allow the franchisor to collect a franchise fee equal to the monopoly rates generated in that market.

2. See, for example, Milgrom and Roberts (1992), p. 564, for a discussion of how randomness in demand growth has been a problem in both the fast-food industry and the automobile dealership industry. We will show that randomness in production can cause a similar problem.

3. A most favored customer clause is a contractual provision that guarantees to a customer that he is receiving the lowest price at which a good is sold to any customer over a specified time period. See Section 2 for a more detailed description.
Our contribution is to extend this analysis to the case where there is uncertainty regarding the optimal number of franchises that should be operating in a given market. Specifically, if it is impossible to write an enforceable contingent contract specifying the number of franchises to be established in each state of the world, then the franchisor will be unable to capture all of the (expected) rents generated in the downstream market when she provides the protection afforded by exclusivity clauses to downstream franchises.

The reason that the use of exclusivity clauses will not allow a franchisor to capture all of the potential expected rents in the presence of noncontractable randomness is simple. The expected profits from selling an input (such as a franchise right) is simply the weighted sum of the rents generated in the final goods market by the number of units of the input that is sold in each state of the world (where the weights are the probabilities of each state occurring). If the optimal number of units of the input to be sold is a (nonconstant) function of a random occurrence in the market, but the monopolist supplier of the input must contractually commit to sell the same number of units regardless of how this randomness is resolved, then those units cannot generate maximum rents in every state of the world. Consequently the monopolist cannot capture the maximum expected rents that could be generated by the input.

We will show that if the monopolist were to employ MFCs instead of exclusivity clauses, then she will be able to commit credibly to sell the optimal number of units in each state of the world. The reason is that the MFC allows the monopolist to choose the number of units to be sold after the randomness is resolved, and creates conditions under which the monopolist earns a payoff exactly equal to the rents generated in the downstream final goods market. Thus, by creating an incentive for the monopolist to sell the optimal number of units in every state of the world, it becomes possible for the monopolist to capture all of the expected rents generated by the input.

Blair and Kaserman (1982) point out that the problem articulated by Caves and Murphy is related to the Coase conjecture regarding the time inconsistency problem faced by a durable goods monopolist (Coase, 1972). Coase proposed that a monopolist who sells a durable good would be unable to capture any monopoly rents because once the monopolist had set a price, and sold units to buyers with a high willingness to pay, she would then have an incentive to lower the price to sell to buyers with lower willingness to pay. He then argued that rational high willingness to pay custom-
ers will expect the price to fall and refuse to purchase at the higher price.4

While the Coase problem and the franchisor's problem outlined previously are related, they are analytically different problems. In the time inconsistency literature on the Coase problem, there is a heterogeneous set of customers. The value each customer receives from consuming the durable is exogenously fixed and therefore is independent of the number of units sold. In our model all customers are identical. The value each customer receives from using the durable is endogenously determined in equilibrium and therefore is a decreasing function of the number of units sold. Thus, our formulation is more naturally interpretable as having customers that are downstream producers who buy an essential input (such as a franchise right) from a monopolist and then compete against each other in the final goods market.5 The time inconsistency literature's formulation, on the other hand, more closely corresponds to a market for a final consumer durable.

The technical difference between these two models is addressed more fully in DeGraba (1992b), but we note that the two problems differ substantively. Bagnoli et al. (1989) show that with a discrete set of potential buyers possessing exogenously given valuations for the good, the monopolist is able to perfectly price discriminate. However, with essentially the same parameterization, we show that the time inconsistency problem remains when such buyers have interdependent valuations for the durable.6

In Section 2 we present a discussion of the institutional details surrounding exclusivity clauses and MFCs. In Section 3 we present our formal model and show that when a supplier sells a durable input to a discrete number of downstream competing producers, in equilib-

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4. A good deal of literature has been devoted to formalizing the arguments of Coase. See, for example, Bulow (1982), Stokey (1981), and Gul et al. (1986) for the seminal work in formalizing Coase's argument, and, more recently, Bagnoli et al. (1989) and Ausubel and Deneckere (1989) for a reexamination of the early results.

5. It is possible to apply our results to certain final goods markets as well. If we think of the durable as a "status" final good such as the most recently designed sports car for which each potential customer is willing to pay a premium if he knew that he would be the only owner of such a car in his neighborhood, then the results of our model apply. The essential feature of our model is that the value each buyer places on the durable is a decreasing function of the number of units sold.

6. The difference arises from the fact that in the case of heterogeneous consumers the area under the demand curve \( p = p(q) \) from 0 to any outlet level \( q \) is the consumers' willingness to pay for the \( q \) units. In the case of identical consumers the consumers' willingness to pay is given by the rectangle generated by the product of price and quantity, \( pq \).
rium she will sell the input for a price equal to the marginal cost of producing the input. In the fourth section, we show that the use of most favored customer clauses allows the supplier to earn the static monopoly rents from the sale of the input. In Section 5 we present an example in which the use of MFCs can dominate the use of exclusivity clauses in solving the time inconsistency problem. In Section 6 we examine two “real world situations” that illustrate our results.

2. Exclusivity Clauses and Most Favored Customer Clauses

As stated in the previous section, when the supplier of a durable input sells to a downstream producer, she may wish to guarantee the producer that he will not find himself in competition with other users of that input. The most direct way to accomplish this is to include in the contract an exclusivity clause, which is a provision that limits the supplier from selling units of the input that would create competitors for the original producer.

Such clauses have been used in a wide variety of markets and can take one of three basic forms. The first is a clause that gives a dealer exclusive rights to sell a product to a specified group of customers and only that group of customers. Such clauses were used by White Motors, who franchised truck dealers and limited each dealer to sell to customers in a specified geographic area. The second type specifies the location of possible future dealers (but places no specific restrictions on the customers they can serve per se). GTE Sylvania used this type of clause when it specified the exact locations of all its dealers of television sets. The fast-food industry uses a form of this clause that typically stipulates that no new franchises can be opened within a specified distance of an existing franchise. In the third form the seller grants exclusive rights to a single buyer for a specified period of time. For instance, the author of a book typically grants exclusive rights to a single publishing company to publish the work. Similarly in the early days of Hollywood, an actor or actress would agree to work exclusively for one studio for either a specified time or until a specified number of movies were made.

7. Price will not be exactly equal to the marginal cost of production because of the well-known integer problem.

8. Butz (1990) showed that MFCs can alleviate the time inconsistency problem when there is a heterogeneous set of customers with independent valuations for the durable. The case of interdependent customers was analyzed simultaneously and independently in DeGraba (1987b).
There are two (related) explanations for why such clauses are used. The first is the "free rider" argument, which says that if a buyer of the input can incur a cost (such as advertising) to increase the demand in the downstream market, he will only incur that cost if he can capture the additional value created by the increase's demand. The exclusivity clause ensures a franchisee that once he improves the value of a market, a new franchise will not be able to enter and capture some of the benefits. The second explanation is that put forth by Caves and Murphy (1976), which says that a franchisee must be protected from the possibility that the franchisor will create a competing franchise, thus eroding the value of the original franchise. Clearly, the use of exclusivity clauses is the most direct way to solve each of these problems. We will show that the use of most favored customer clauses (MFCs) can be an indirect but more profitable way to solve the latter problem.

A most favored customer clause in a sales contract stipulates that the seller must charge the buyer a price that is less than or equal to the lowest price the seller charges any other buyer during a specified time period. So if a seller sold units of a good to one buyer for a price of $10 per unit and offered an MFC, and sold units to a second buyer for $8 per unit within the time period specified in the MFC, the seller would refund to the first buyer $2 per unit.

MFCs are most widely used in contracts between wholesalers and retailers. For instance, a department store that is selling a particular line of clothing may request a most favored customer clause to insure that it won't be competing against another department store that sells the same line, but was able to negotiate a lower price. Thus, the MFC's primary use is to ensure downstream distributors of the same good that they will all have the same marginal cost of obtaining the good.

The use of most favored customer status can affect markets in ways unrelated to ensuring the equality of marginal cost between competitors. In the remainder of this paper, we will examine one such effect that the use of MFCs can have on a market. We will show that the seller of an input can use an MFC to provide the same type of protection provided by the use of exclusivity clauses. Theoretically, these clauses could be used to provide such protection in markets for

9. The antitrust literature contains an in depth analysis of these arguments. See Preston (1989) for an excellent summary of this analysis.
10. See Section 6 for a brief list
Exclusivity Clauses and Best Price Policies

3. The Model

We present a formal model in which a monopoly supplier of an input, who is unable to contractually limit future sales, sells each unit at an equilibrium price that equals the marginal cost of producing the input.

Consider the following two-stage game, $\Gamma$. A monopolist (henceforth called the supplier) supplies a durable (henceforth called the input) that is necessary for the production of a final good. There are $n$ downstream firms (henceforth called the producers) that can produce the final good if they purchase the input. The producers who purchase the input compete against each other in the final goods market. The supplier can produce as many units of the input as she chooses at a constant marginal cost, $M \geq 0$. The supplier maximizes profits from selling the input to the producers.

Each producer has the option of buying or not buying the input. If a producer does not buy the input, he cannot produce the final good and therefore earns a payoff of zero. If a producer does purchase the input, he produces the final good and competes against all other producers in the final goods markets. A producer needs one unit of the input to produce any level of output, and each producer is assumed to be an expected profit maximizer.

In stage 1 of $\Gamma$, the supplier sells the input to the downstream producers. He offers producer 1 a price, $c_{11}$, which producer 1 can either accept or reject. Once this decision is made, the supplier offers $c_{21}$ to producer 2, who can either accept or reject the offer. This process continues until the supplier has made an offer to all $n$ producers. If the offers made in round 1 are all accepted or all rejected, stage 1 is over. If some producers accept and others reject, the supplier makes a

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11. The essential feature of our model is that buyers have interdependent valuations for the durable. Such interdependence most naturally occurs among competing firms that use the same durable input in the production process. It is possible for such an interdependence to exist among purchasers of a final good such as rare art work whose value is determined in part by the number of additional works by the artist that are on the market.
second round of price offers, $c_{ij}$, to each producer, $i$, who rejected their initial offer. If all of the producers to whom offers are made in round 2 either accept or reject these offers, then stage 1 is over. If some accept and some reject, then the supplier makes a third round of offers, $c_{ik}$, to those producers that rejected offers in round 2. This process continues until all producers to whom offers are made in a round either accept or reject their offers. When this occurs, stage 1 is over. (Because $n$ is finite, stage 1 must end in a finite number of steps.)

In stage 2 those producers that accepted an offer compete in the final goods market. The specific form of the competition at this stage is unimportant for our results. We make only the following assumptions regarding the downstream competition.

1. The revenue (net of all production costs other than the cost of the fixed input sold by the supplier) earned by a particular producer depends only on the total number of producers that compete in the final goods market. We denote the revenue of producer, $i$, when there is a total of $j$ producers including producer, $i$, by $R_{ij}$.

2. All producers competing in the final goods market earn identical revenue: $R_{ij} = R_{ik}$ for all $i, j, k$. For ease of notation, we will suppress the subscript $i$ where no confusion will arise.

3. The revenue received by a producer is monotonically increasing in the number of competitors to a point and then monotonically decreasing thereafter. Formally, there exists a $j^*$ such that if $j' \leq j^*$ then $j'R_{ij} > j''R_{ij}$ for $j'' < j'$ and if $j' > j^*$ then $j'R_{ij} < j''R_{ij}$ for $j'' < j' \leq n$.

4. $n$ is large enough so that if all $n$ firms compete in the final goods market, then each firm earns a revenue that is less than the marginal cost of producing the input, that is, $R_j < M$ for $j = n$.

These restrictions are quite mild. Assumptions 1 and 2 are simply symmetry conditions. Assumption 3 allows us to consider a wide range of forms of competition in the final goods market. For instance, setting $j^* = 1$ allows us to consider revenue profiles that are consistent with "standard forms of competition" such as the producers competing as symmetric Cournot oligopolists or price competitors symmetrically placed along a Hotelling circle. As Katz and Shapiro (1985) point out, if production of a final good is subject to increasing marginal costs, or if there is a possibility of product differentiation, industry profits could be increased by the entrance of a new competitor. It is

12. It could be argued that situations in which industry revenue increases with additional entrants may imply suboptimal behavior on the part of incumbent firms. If
also well known that network externalities can create a situation in which revenue is an increasing in the number of sellers. Both of these cases can be modeled by setting \( j^* \geq 2 \). Assumption 4 is made for analytical ease and will be relaxed later (in Corollary 1) without altering the spirit of our results. These restrictions allow us to consider a reduced form of \( \Gamma \) where the players make their first-stage choices and the results of the second stage are treated parametrically.

Formally, the strategy for the supplier is a function, \( C \), that maps the offer and acceptance history of \( \Gamma \) into the next offer. We will denote as \( c_{ik} \) the offer made to producer \( i \) in round \( k \). The subscript, \( k \), will be suppressed where no confusion will arise. The strategy for a producer is a function, \( A_{iv} \), that maps the offer and acceptance history of \( \Gamma \) into which offers to accept.

The supplier’s payoff is the revenue that she receives from the sales of the inputs less the cost of producing the inputs for all \( i \) that purchase the input at the price \( c_{iv} \), \( \pi_0 = \sum_i (c_i - M) \). The payoff to a producer that does not purchase the input is zero. A producer who does purchase the input earns a payoff equal to the difference between revenue and the purchase price, \( \pi_i = R_i - c_i \). The equilibrium concept is that of subgame perfect Nash equilibrium (Selten, 1975).

We begin by stating the time inconsistency problem for our model. As we stated in the introduction, this result is important because Bagnoli et al. (1989) showed that, when there is a discrete set of customers with independent valuations for the durable, there is no time inconsistency problem.

**Proposition 1:** Let \( j > j^* \) be the \( j \) for which \( R_j > M > R_{j+1} \). In every perfect Nash equilibrium of \( \Gamma \), exactly \( j \) firms purchase the input at a price of \( R_{j} \).

**Proof.** See appendix \( \Box \)

While the proof may be a bit tedious, the intuition is simple. If a single supplier of a durable input is unable to commit herself credibly to

an entrant could profitably enter, an incumbent could have duplicated the entrant’s new facility, internalized the competition externality that the entrant would have created, and therefore earned a higher profit than he and the entrant combined. Equivalently, the incumbent could simply buy the competitor once it entered and once again internalize the competition externality.

On the other hand, it might be possible to consider the downstream firms as two retail outlets and the supplier as someone who is selling the right to market a new item. If each retailer has a geographic advantage in a particular area, then the revenue generated from selling the good through both outlets might exceed the revenue generated by selling through a single outlet. (We assume antitrust laws prevent the merger of the two outlets.)
forgo future sales of the input, she will sell enough units so that the profit generated by each downstream firm is "just greater than" the marginal cost of producing the input. This profit will be the price at which she sells each unit.

While this game might not appear to be "as dynamic" as those found in the time inconsistency literature (i.e., Bulow, 1981; Gul et al., 1986, etc.), it is really quite similar. A dynamic game has two salient features: the sequencing of actions and the time between those actions. In the time inconsistency literature, the models are presented as games where actions take place in a particular sequence over time. The equilibria of such games are calculated, and then the analysis is performed on the equilibria in the limit as the time between actions approaches zero. Hence, in all of these games (except for Ausubel and Deneckere, 1986, when they allow nonstationary strategies) all of the sales transactions occur arbitrarily close to the beginning of time. Thus, our model can be thought of as the formal model of the game they describe in the limit, where the time between offers equals zero. This model highlights the essential sequence of actions that constitutes the time inconsistency problem in our setting, which is that once a producer purchases a unit, it is always possible for the supplier to find another producer to purchase it at a lower price.

We now relax assumption 4 so that \( R_n > M \), and show in Corollary 1 that the basic intuition of Proposition 1 still holds, that is, when selling the input the supplier is unable to restrict sales to \( j^* \) downstream producer.

**Corollary 1:** If \( n \) is such that \( R_n > M \), then the unique Nash equilibrium has every producer purchasing the input at a price of \( R_n \).

**Proof.** The induction is constructed as in the proof of proposition 1. If \( n - 1 \) units are sold, then (by Lemmas 2 and 3) the only subgame perfect continuation involves the \( n \)th producer purchasing the unit at a price of \( R_n \). Similarly if \( n - 2 \) units have been sold, then the producer that is contemplating the purchase of the \( n - 1 \)st unit knows that if he purchases it, the \( n \)th unit will be sold as well. Hence, the highest price at which the \( n - 1 \)st unit can be sold is \( R_n \). This induction applies to all units.

Lemmas 2–4 from the appendix can then be used to show the input will never sell for less than \( R_n \) in equilibrium. Finally, note that the strategy combination in which the supplier offers every producer \( R_n \) and every producer accepts any price less than or equal to \( R_n \) is a subgame perfect Nash equilibrium. \( \square \)
It might appear that the preceding analysis implies that the market will always provide an efficient amount of the input, but this may not be the case. There are situations where the supplier’s inability to limit future sales can lead to a complete market failure. For instance, suppose that the supplier must first decide whether or not to produce the input and that she must incur a fixed cost, $F$, if she does decide to produce. If $F > j(R_f - M)$ then the supplier will be unable to earn a nonnegative profit from the sales of the input and therefore will choose not to produce it. If $j^*R_f > F + j^*M$, then this result is suboptimal because this condition implies enough demand to warrant the production of the final good. (Of course if $F < j(R_f - M)$ the market will provide the efficient outcome.)

We conclude this section by showing that a supplier who can limit the quantity sold will be able to capture all of the monopoly rents from the final goods market.

**Proposition 2.** If the supplier can limit herself to selling a specific number of units, she sells $j^*$ units, each at a price of $R_f$.

**Proof.** The strategy combination in which every downstream firm accepts any price $\leq R_f$ and the supplier offers $R_f$ to the first $j^*$ producers is a Nash equilibrium. If $j^*$ units are sold, then the subgame perfect continuation is for no further units to be sold. This is a direct consequence of Lemmas 2–4. Now note that if $j^* - 1$ units have been sold for a price of $R_f$, then the $j^{th}$ unit is also sold for a price of $R_f$. Similarly, if $j^* - 2$ units are sold at the price of $R_f$, then the $j^* - 1$st will be sold at a price of $R_f$. A standard induction argument shows that all previous units will also be sold at a price of $R_f$. □

In the remainder of this paper, we will compare contractual arrangements a supplier might use to commit credibly to limiting her future transactions. It is well known that forward vertical integration provides an alternative to market transactions that may be used to accomplish this. By purchasing the optimal number of downstream producers, the supplier can internalize the externality of potential future sales and thus reap the monopoly profits of the downstream final goods market.13 Because, as an empirical matter, we do observe dura-

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13. There is an extensive literature on why a supplier would choose to sell through franchises as opposed to integrate forward into distribution. Such reasons include managerial diseconomies, capital markets imperfections, risk sharing, and information problems. Such arrangements also create their own set of problems including variable proportions, free riding, successive monopoly, and time inconsistency.
ble inputs being sold in arm's-length market transactions, we will focus our attention on alternative contractual remedies to the problem.

In the next section we present a simple market setting and show that using MFCs will enable the supplier to capture all of the monopoly rents that can be generated in the downstream market. In the subsequent section we introduce several market settings that incorporate some source of randomness. We show that in each case the supplier would choose to use MFCs as a method of solving the time inconsistency problem as opposed to exclusivity clauses.  

4. MFC's as a Solution to the Time Inconsistency Problem

In this section we show that the use of an MFC can solve the time inconsistency problem outlined in the previous section. We modify the model of the previous section by allowing the supplier to offer an MFC along with the price offer. Proposition 3 shows that allowing the supplier to offer an MFC eliminates the time inconsistency problem.

**Proposition 3.** If the supplier offers an MFC along with every price offer, then in equilibrium she sells \( j^* \) units of the input each at a price of \( R_{j^*} \).

**Proof.** See appendix. \( \square \)

The intuition behind this result is quite simple. The use of an MFC ensures that the supplier earns a payoff exactly equal to the revenue generated in the final goods market. Hence, her incentive is to sell the number of units of the input that maximizes revenue. To see this, assume that the supplier has sold the input to \( j^* \) producers at a price of \( R_{j^*} \). The use of an MFC commits the supplier to refund to these producers an amount equal to the price differential if she ever sells an additional unit to another producer at a lower price. Because another producer would never pay more than \( R_j \) for the input if \( j - 1 \) units have already been sold, such a transaction would result in a reduction in the supplier's payoff (recall that \( j' R_{j'} < j'' R_{j''} \) for \( j' \leq j'' \leq n \)). Therefore, the supplier will never initiate a transaction after she sells unit \( j^* \).

While MFCs provide a theoretical solution to the time inconsistency problem, we must point out that there is a practical difficulty in implementing such a policy. If it is costly to monitor transactions

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14. The idea that MFCs can solve the time inconsistency problem can also be found in Butz (1990).
between the supplier and a producer, then it may be possible for the supplier to offer MFCs, but then circumvent them by offering some producers secret rebates. Whether or not monitoring is too costly to make MFCs a practical tool is clearly an empirical question. While we are not aware of any systematic studies of when MFCs have been used, we can point out that there are documented cases (such as General Electric’s use of MFCs in selling turbine generators and Adobe System’s use of MFC’s when selling Postscript) in which MFCs are used successfully.

5. Choosing Between Solutions When Faced With Noncontractable Randomness

We have shown that an input supplier may use MFCs to solve the time inconsistency problem. Because it is well known that a supplier of a durable could potentially use exclusivity clauses to solve this problem as well, it is useful to understand under what conditions a supplier is likely to choose one solution over the other.

In this section we will show that noncontractable random demand in the final goods market, which affects the optimal number of producers, can create a situation in which the use of MFCs dominates the use of exclusivity clauses. As we will see, this dominance arises because with exclusivity clauses the supplier must specify ex ante the number of units of the input that will be sold. Therefore, there must be at least one state of the world in which a suboptimal number of units will be sold ex post. Hence, the input cannot generate maximum (expected) rents. The use of MFCs, however, enables the supplier to sell the ex post optimal number of units of the input in each state of the world, thereby generating the maximum rents.

To understand why MFCs work, suppose a producer purchases the input expecting it to be profitable. If another producer subsequently wishes to enter, then this entrant must expect to make a profit as well. As long as the incumbent is guaranteed the same terms as the entrant (which is what an MFC does), the incumbent will be profitable. (This argument assumes that the entrant is not so much more efficient than the incumbent that the resulting competition will be profitable for the entrant but not for the incumbent; if there were such an entrant, she would be the logical producer to purchase the input in the first place. It also assumes that the entrant is not making a mistake by entering.)

Before we compare the use of MFCs to the use of exclusivity clauses, we should mention a third possible solution (suggested by Coase, 1972, and later formally modeled under specific conditions by
Bulow, 1982), which is the use of short-term lease or rental agreements. While the result is well known in the context of a durable final good, recent work by DeGraba (1992b) demonstrates that there are conditions under which leasing will not solve the time inconsistency problem when the durable is an input. One such condition is the case in which the producer must sink a product specific investment in order to use the input. In the two examples that follow, we assume such an investment is necessary, a result of which is that short-term leasing will fail to solve the time inconsistency problem.

We now formalize these ideas using an example based on the model of Section 2. In this example the use of an MFC yields the supplier a higher payoff than does the use of an exclusivity agreement. In addition we show that the use of short-term leases cannot solve the time inconsistency problem. We remind the reader that this example is not meant to be a completely general model of the market conditions under consideration; rather it is meant to be the simplest possible example that illustrates interesting market conditions under which the use of MFCs dominates the use of exclusivity clauses.

**Example: Random Demand**

There is a final goods market that can be served by two (potential) producers. At time 0, demand in this market is low. At time \( t \), demand will either remain low with probability \( p \) or become high with probability \( (1 - p) \). For simplicity we assume that the state of demand remains constant into the infinite future after time, \( t \). \( R_{1t} \) is the revenue earned each year (into the infinite future) in the low state if one producer operates in the final goods market, and \( R_{2t} \) is the yearly revenue earned by each producer if both produce in the low state. The corresponding revenues in the high state are \( R_{1h} \) and \( R_{2h} \). Without loss of generality, we let \( M = 0 \).

We assume that the state of demand will be revealed only after at least one producer is operating in the market at time, \( t \). This captures the idea that the only way to know consumer demand with certainty is through revealed market behavior. While the state of demand is observable, we will assume that it is not third-party verifiable. Hence, an ex-ante enforceable contract cannot be written as a function of the demand.

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15. DeGraba (1992a) shows that in cases where leasing does solve the time inconsistency problem, an infinite number of short-term leases is required to obtain a first best solution.

16. This must be a cost which the supplier is unwilling to pay because of agency reasons or unable to pay perhaps because of capital or credit constraints. Otherwise the supplier could pay this cost and collect it through a higher lease payment.
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resolution of the randomness. This is consistent with the idea that while two firms might be willing to contract based on their beliefs about the business climate (more specifically in this case, excess demand), demand behavior does not generate variables upon which it is easy to write a contingent contract.  

In order to enter the market each producer must sink a nonrecoverable expenditure of $S$. Letting $r$ be the common interest (discount) rate, we assume that

A1.1.  \[ R_{1t}/r - S > 2R_{2t}/r - 2S \]
A1.2.  \[ 2R_{2t}/r - 2S > R_{1f}/r - S. \]

A1.1 says that in the low state of demand industry profits are maximized if a single producer operates in the final goods market, and A1.2 says that because of some diminishing marginal returns, in the high state it is more efficient to have both producers selling in the final goods market.  

Given this structure, we construct the following three-player game. Before the state of demand is known, the supplier makes sequential take-it-or-leave-it offers to each of the producers for the right to serve (compete in) the market. If neither producer accepts, the game is over, and all players earn a payoff of zero. If one producer accepts an offer, he must sink $S$, and if both producers accept, they must each sink $S$. At time $t$ the randomness is resolved (assuming that at least one producer has purchased the input) and the supplier can make an offer to the producer (if any) that has not yet accepted an offer. Because the magnitude of $t$ has no affect on actions taken after the state of demand is resolved, we can assume without loss of generality that $t = 0$. We must simply retain the assumption that the state of the world is unobservable until at least one producer begins to operate in the market. Hence, once one producer sinks $S$, the state of demand is resolved, and the supplier may make another offer to the producer that has not yet accepted an


18. Assumptions A1.1 and A1.2 are consistent with many market settings. For instance, consider the demand for a fast-food chain in a small town. If demand is low, then only one owner-run outlet is optimal. However, if demand is high, then it is optimal to have two owner-run outlets. (This argument assumes one owner cannot run all of the outlets that would be optimal in the high state of demand). Alternatively we can think of a line of clothing that is sold through department stores. If the demand for the line is low, then it is optimal to sell it through a single department store chain, whereas if demand is high, then it is optimal to sell it through two department store chains.
offer. Once the offers are accepted, each producer earns a payoff equal to the revenues as described earlier, less $S$ and payments made to the supplier in accordance with their offers. Each player is an expected NPV maximizer.

Given this basic structure we can compare the subgame perfect Nash equilibria of three games. In the first game the supplier sells the input to producers, and can also write an exclusivity clause that grants exclusive territorial rights to the market to either a single producer or both producers. In the second game the supplier sells the input and is able to include an MFC. In the third game the supplier offers short-term lease contracts to the producers instead of sales contracts.

**Proposition 4:** When the optimal number of producers operating in the low state of demand is less than the optimal number in the high state, the use of an MFC provides greater expected profit to the supplier than does the use of an exclusivity clause. In addition the use of an MFC provides a greater expected profit than does the use of a short-term lease agreement, which fails to solve the time inconsistency problem when $S$ is sufficiently large.

**Proof:** Equilibrium Using Exclusivity Clauses. When the supplier can write an exclusivity clause, she can choose to restrict sales to one producer, thus generating an expected revenue stream with an NPV $= (\rho R_{ul} + (1 - \rho)R_{hi})/r$. Because producer $1$ must sink $S$ in start-up costs, in an equilibrium with such a restriction he pays $(\rho R_{ul} + (1 - \rho)R_{hi})/r - S$. The supplier therefore earns a payoff of $(\rho R_{ul} + (1 - \rho)R_{hi})/r - S$, and the producer who purchases the input earns an expected payoff of 0 as does the producer who does not purchase the input.

The supplier could alternatively choose to allow both producers into the market by writing a clause that specifically states that two units of the input will be sold. In such a case producer $1$ will purchase the input at a price of $(\rho R_{ul} + (1 - \rho)R_{hi})/r - S$, and producer $2$ will purchase the input after the resolution of the uncertainty at a price equal to the duopoly revenue that prevails in the revealed state of demand, less $S$. Hence, the supplier would earn an expected payoff of $(\rho 2R_{ul} + (1 - \rho)2R_{hi})/r - 2S$ when she allowed two producers to enter, while each producer earns an expected payoff of 0.

Depending on the parameters, either choice could be optimal. Clearly if $(\rho R_{ul} + (1 - \rho)R_{hi})/r - S > (\rho 2R_{ul} + (1 - \rho)2R_{hi})/r - 2S$, the supplier would choose to offer an exclusivity clause that allowed one unit of the input to be sold, while if the inequality were reversed the supplier would offer a clause in which two units of the input could be sold.
Equilibria Using MFCs. When using MFCs, we must consider two cases.

Case 1 $R_{1L} > R_{2H}$. In equilibrium producer 1 accepts a price of $R_{1H}/r - S$ before the state is revealed. This price will prevail in the low state. In the high state the supplier will offer producer 2 a price of $R_{2H}/r - S$ and refunds $R_{1L}/r - R_{2H}/r$ to producer 1. Again the producers earn expected payoffs of 0, while the supplier earns an expected payoff of $\rho(R_{1H}/r - S) + (1 - \rho)2(R_{2H}/r - S)$.

Case 2 $R_{1L} < R_{2H}$. In equilibrium producer 1 pays $(\rho R_{1L} + (1 - \rho)R_{2H})/r - S$ and after the state of demand is revealed producer 2 pays $R_{2H}/r - S$ if demand is high and of course no additional sales are made if the state of demand is low. Again the producers earn expected payoffs of zero, while the supplier earns an expected payoff of $\rho(R_{1H}/r - S) + (1 - \rho)2(R_{2H}/r - S)$.

A comparison of the equilibrium payoffs associated with exclusivity clauses and the payoffs arising from MFCs reveals that the supplier earns more from using MFCs. In cases 1 and 2 $\rho(R_{1H}/r - S) + (1 - \rho)2(R_{2H}/r - S) > \max \{\rho R_{1L} + (1 - \rho)R_{1H}/r - S, \rho2R_{2L} + (1 - \rho)2R_{2H}/r - 2S\}$.

Equilibria Using Short-term Leases. In the third game the supplier offers short-term leases. At time 0 the supplier makes sequential offers to producers 1 and 2, which consist of a fixed-per-period lease payment (i.e., the lease rate). Once these have been accepted or rejected, each producer that has accepted sinks S. Randomness is then resolved and after observing the outcome; each producer that accepted a lease has the option of cancelling his lease. Cancelling a lease means that a producer relinquishes all rights to future revenues. Once these decisions have been made, the supplier then offers leases to any producer who has not yet accepted an offer or who has cancelled a lease. If any of these leases is accepted, producers have another opportunity to cancel their leases. If any producer does cancel,

19. Many franchise arrangements require the franchisee to pay for a minimum number of units each year. While such performance contracts solve the well-known double-marginalization problem, they effectively create a situation in which the lease payment is a fixed amount per period. Other arrangements (such as fast-food and first-run movies) require the payment to be a simple percentage of gross sales without any minimum payment. It is possible to construct examples in which either fixed lease payments or lease payments that are a percentage of sales fail to solve the time inconsistency problem. We present an example with a fixed lease payment because it is expositionally simpler and because it more closely corresponds to an application that we present in the next section.
then the supplier can make another offer. This process continues until no producers decide to cancel. At this point revenues are collected, and lease payments are made.

The reader will note that this model is equivalent to a model in which the supplier makes take-it or leave-it short-term lease offers over time. Because a producer that sinks a fixed cost is subject to the hold-up problem, we assume that the supplier can commit to not raising the lease payment and to not cancel the lease once a producer accepts a lease. 20

There are many different equilibria when leasing is possible depending on the relative magnitudes of the parameters. We present two cases to illustrate the possibilities.

Equilibrium 1. We first provide conditions under which leasing enables the supplier to capture all of the expected rents generated by the input. These conditions are:

C1.1. $R_{1L} > \rho R_{1L} + (1 - \rho)R_{2H} - rS$
C1.2. $R_{2H} > \rho R_{1L} + (1 - \rho)R_{2H} - rS$
C1.3. $R_{2L} < \rho R_{1L} + (1 - \rho)R_{2H} - rS$
C1.4. $2R_{2L} - rS < \rho R_{1L} + (1 - \rho)R_{2H} - rS$

C1.1 says that as a monopolist in the low state, a producer would earn a revenue flow each year that is greater than the yearly expected profit when the optimal number of units is sold in each state. C1.2 says that as a duopolist in the high state, a producer would earn a revenue flow each year that is greater than the yearly expected profit when the optimal number of units is sold in each state. C1.3 says that as a duopolist in the low state, a producer would earn a revenue flow that is less than the yearly expected profit when the optimal number of units is sold in each state. C1.4 says that the yearly revenue generated by both duopolists in the low state is less than the yearly expected revenue when the optimal number of units is sold in each state.

In equilibrium, producer 1 accepts a yearly lease with a payment of $\rho R_{1L} + (1 - \rho)R_{2H} - rS$ at time 0. The supplier makes no offer to producer 2. Randomness is then resolved. If the low state is realized, then there are no further transactions. If the high state is realized, then the supplier leases a second unit to producer 2 with a lease payment of $R_{2H} - rS$. The supplier earns an expected payoff of $(\rho(R_{1L} - rS) + (1 - \rho)2(R_{2H} - rS))/r$, while each producer earns 0.

20. These restrictions can easily be accomplished contractually.
management Strategy

Notice that once producer 1 sinks $S$, cancelling a lease leaves him open to the hold-up problem with respect to future leases (i.e., the supplier would offer him a new lease at a rate equal to the revenue that will be generated in the observed state). Hence, as long as the revenue in a state is greater than the lease payment, producer 1 will honor the existing agreement. Note C1.1 and C1.2 imply that producer 1 will honor the lease in the low and high states, respectively. C1.3 implies that if in the low state the supplier opportunistically leased a second unit to producer 2, producer 1 would cancel his lease because the revenue he would earn as a duopolist would be less than his yearly lease payment. C1.4 implies that the supplier would earn more in the low state by collecting the payments on producer 1’s initial lease than she could by opportunistically leasing a second unit and creating a duopoly in the low state. 21

We now provide a set of conditions under which the supplier is not able to capture all of the expected rents generated by the input. These conditions are generated simply by reversing the inequality in C1.4.

Conditions 1’

C1.1’. $R_{1l} > \rho R_{1l} + (1 - \rho)R_{2H} - rS$
C1.2’. $R_{2H} > \rho R_{1l} + (1 - \rho)R_{2H} - rS$
C1.3’. $R_{2l} < \rho R_{1l} + (1 - \rho)R_{2H} - rS$
C1.4’. $2R_{2l} - rS > \rho R_{1l} + (1 - \rho)R_{2H} - rS$

The equilibrium in this case involves producer 1 accepting an initial lease with a rate of $(1 - \rho)R_{2H} - rS$. No offer is made to producer 2. Randomness is then resolved. If the high state occurs, the supplier leases a second unit to producer 2 at a rate of $R_{2H} - rS$. If the low state occurs, the supplier leases a second unit to producer 2 at a rate of $R_{2l} - rS$. Producer 1 then cancels his initial lease, and the supplier offers him a new lease with a rate of $R_{2l}$.

In this equilibrium the producers earn a payoff of zero, and the supplier earns an expected payoff of $[\rho(2R_{2l} - rS) + (1 - \rho)(2 - \rho)R_{2H} - 2rS]/r$, which is less than the equilibrium payoff she receives from using MFCs. □

21. To see this, assume that after producer 1 accepts a lease the state is revealed to be low. If the supplier leases a second unit to producer 2 for a rate less than or equal to $R_{2l}$, then producer 1 knows that there will be a duopoly in the low state. C1.3 tells us that the revenues in this case do not cover the lease payments, so producer 1 cancels the original lease. Once this occurs, the supplier offers and producer 1 accepts a new lease with a rate of $R_{2l}$. 
To see why MFCs dominate the use of exclusivity clauses in this example, note that the supplier finds it optimal to have one producer serving the market in the low demand state and two producers serving the market in the high state.

If the supplier uses an exclusivity clause, she must ex ante specify the number of units of the input that will be sold. Because the randomness is (by assumption) noncontractable, this number cannot be contingent on the state of demand. The problem that this creates is obvious: Restricting sales to one producer prevents the supplier from accessing large profits if demand is high. On the other hand, allowing the possibility of two producers to purchase the input can leave the initial purchaser vulnerable to future opportunist behavior on the part of the supplier when demand is low. Because optimality requires a different number of producers in each state of demand, the use of an exclusivity clause guarantees that maximum expected rents can never be generated in the final goods market.

The use of an MFC, on the other hand, enables the supplier to commit to selling the optimal number of units of the input in each state of demand. Initially she can sell the optimal number of units for the low state of demand. If demand then turns out to be low, no further sales are made because the MFC makes future opportunist sales unprofitable for the supplier. If, on the other hand, demand is high, the supplier can sell more units of the input. If this should require her to lower the price, the MFC protects the original purchasers. So the supplier can extract the maximum expected rents that can be generated in the final goods market by employing MFCs.

It is instructive to examine in more detail how the MFC works in this example. First, in both case 1 and case 2, one role played by the MFC is to guarantee to producer 1 that he will be a monopolist in the low state of demand, thus solving the time inconsistency problem in that state, enabling the supplier to extract maximum expected rents from that state. Second, in case 1 the MFC plays a second role, which is to ensure the initial producer that he will earn a nonnegative profit in the high state of demand by requiring the supplier to pay the refund $R_{1H} - R_{2H}$, thus allowing the supplier to extract maximum rents from the high state as well. Notice that in case 2, there is no role for the MFC in the high state of demand because $R_{2H} > R_{1H}$, and there are no additional producers. (Note that if there had been a third producer in this model that created sufficient competition so that $3R_{3H} < 2R_{2H}$, our equilibrium would remain unchanged, and the MFC would serve the same purpose in the high state as well.)

In summary, the use of MFCs can dominate the use of exclusivity clauses in the presence of noncontractable randomness that affects
the optimal number of units to be sold. The reason is that using exclusivity clauses creates a cost associated with the fact that the supplier must state explicitly the number of units that will be sold before the randomness is resolved. When using MFCs, the supplier need not make such an up-front commitment and so avoids this cost.  

The reason why MFCs can dominate the use of short-term lease can be understood by examining why the solution that worked under Conditions 1 does not work under Conditions 1’. Suppose that producer 1 did accept a lease with a rate of $pR_{1L} + (1 - p)R_{2H} - rS$ at time 0. A problem arises in the low state of demand. If the supplier entered into no further transactions, she would collect $pR_{1L} + (1 - p)R_{2H} - rS$ each year. However, she could collect a higher payoff in the low state by creating a duopoly, charging producer 2, $R_{2L} - rS$ and charging producer 1 $R_{2L}$. Thus, leasing will not solve the time inconsistency problem in the low state of demand, because the lease payment agreed upon before the randomness is resolved is not sufficiently high to prevent opportunistic behavior once the randomness is resolved. Consequently, the supplier cannot extract maximum rents in the low state.

MFCs can solve the problem when leasing cannot because with an MFC, the incumbent is guaranteed to be at least as well off as an entrant. So long as an entrant finds it profitable to enter, the incumbent will find it profitable to remain. This example demonstrates that in a dynamic setting, leasing cannot guarantee the incumbent the same position as the entrant because in the low state, producer 2 pays a lease rate of only $R_{2L} - rS$, while the producer 1 pays a lease rate of $R_{2L}$.

### 6. Applications

We now consider two real-world examples that illustrate our results. Each example demonstrates the value of an MFC in a situation where the optimal number of units cannot be determined at the time the first unit is sold and the supplier is unwilling to explicitly commit ex ante to a specific number of units that will be sold.

The first illustration of the value of (or more accurately the prob-
lems caused by the lack of) an MFC is the case of Benetton. Benetton licenses to individual shop owners the right to sell Benetton knitware (sweaters). Benetton charges no up-front fee and no annual franchise fee but does require owners to purchase a minimum number of sweaters each year (which, if binding, is equivalent to an annual franchise fee). In addition, each owner must make a large initial investment to equip a store, etc.

Several store owners have sued Benetton, claiming that other franchises were opened after theirs, and that the new franchises were profitable while their own stores were losing money. They claimed that these new franchises were getting better terms than initial franchises. Benetton claims that the market is large enough to support all of the outlets that it opened and that the reason some stores were going out of business was that they were mismanaged by the parties now bringing the suit. If these suits are successful, the courts would most likely provide a remedy that would result in the same allocation as would an MFC (ignoring, of course, socially wasteful legal fees).

Our second example depicts a different situation in which the optimal set of downstream producers differs across states of the world. In this example, it is uncertainty regarding a future potential entrant’s type (as opposed to random demand in the final goods market) that causes the supplier to earn a suboptimal payoff if she specifies ex ante the number of units that she will sell. Appendix B presents an example that formally models randomness in producer types.

Consider the problem faced by Adobe Systems. Adobe is a licensing company that licenses (among other things) the use of the Postscript system for laser printers. Because of the advantages of establishing Postscript as the industry standard, Adobe would like to license Postscript to as many “major” producers of laser printers as possible. However, Adobe also wishes to commit to preclude licensing Postscript to “clone producers” (clones produce imitations of the products


24. Benetton’s claim that the original stores are simply mismanaged seems unlikely given the fact that the stores were run at a profit before entry and that most managerial decisions (including prices, the number of sales people, the types of in-store displays, and type of merchandise) are dictated by Benetton and that outlets are virtual carbon copies of each other.
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sold by the major producers and compete on price), because competition from clones would reduce the profits in the market for laser printers and, thus, the value of the license.

Thus, Adobe must find a way to ensure early licensors of Postscript that clones will not be allowed to license this technology, while permitting other major producers to license Postscript in the future. Clearly, the use of an exclusivity clause will not work. A clause that severely limits the number of possible producers could foreclose profitable opportunities should many major producers wish to license Postscript, while a clause that allows for many potential producers could allow Adobe to eventually sell to clones in the event that "not enough" major producers license Postscript.

Adobe's solution to this problem is to use a licensing agreement in which a licensor must pay a large one time fee plus a percentage of the revenue of all printers sold using the technology. Adobe also offers an MFC to each customer. As one member of the industry told us, the strategy of charging a large initial fee was implemented in order to keep small producers (clones) out of the market, and the use of MFCs ensures that Adobe will not lower this fee once all of the major producers have adopted the technology.

The idea that price protection policies can affect a market's equilibrium is not unknown to the literature. In an oligopolistic market, Cooper (1986), Holt and Scheffman (1987), and Salop (1986) have shown that MFCs can be used to facilitate collusion. DeGraba (1987a) shows that an MFC used by a national firm will cause local firms to be more competitive in their choice of products. DeGraba (1990) shows that the use of an MFC by an input supplier can affect the choice of technology employed by downstream firms.

In examining how a monopolist might use an MFC, Butz (1990) shows that an MFC can mitigate the time inconsistency problem of a single seller of a durable good. While his work focuses on the situation where each purchaser has a valuation for the durable that is independent of who else buys the good, our work focuses on the independence of downstream competitors. Butz (1988) has shown

25. This information was obtained from several people involved in the production of computer hardware.

26. Note also that each firm that licenses Postscript must incur a large product specific cost in order to develop a printer that will be compatible with the Postscript technology. This would make subsequent termination of the relationship prohibitively costly, thus ruling out leasing as a solution to Adobe's marketing problem. In Appendix B we provide an example that formalizes the argument presented previously.
that MFCs may be used to mitigate the problem of appropriating quasi-rents from owners of firm specific capital.\textsuperscript{27}

Coase (1972) suggested that a monopolist could offer to buy back the durable at a price just under the original purchase price at any time the buyer requests as a way of insuring the integrity of future prices. Coase's suggestion, along with the buyer's ability to then repurchase the input at the current market price, would have the same effect as an MFC in our simple model.\textsuperscript{28}

The lesson to be learned from this section is quite simple. In a situation in which a time inconsistency problem exists and a future random event will determine the optimal number of units of the durable to be sold, if an exclusivity clause cannot be made a function of the random event, then a Most Favored Customer clause will dominate the use of an exclusivity clause.

We conclude this section by pointing out that the usefulness of MFCs may not be restricted to situations in which the optimal number of downstream producers varies with the state of the world. To see this, assume that demand is random but that in any state of the world, one producer generates a higher revenue than two producers. If all parties agree on the probability distribution of the randomness and are risk neutral, then the supplier can capture all of the expected rents from this market by offering an exclusivity clause at a price equal to the expected monopoly rents generated in this market less any sunk cost incurred by the producer. Thus, the supplier simply establishes a monopolist in the market and sells the monopoly position at a price equal to the monopoly rents.

While this example presents simple conditions under which a

\textsuperscript{27} This work, which was developed simultaneously but independently of ours, bears some structural resemblance to the arguments made in this section.

\textsuperscript{28} We are grateful to an anonymous referee for pointing this out. Again, we emphasize that while Coase suggested this repurchase in order to convince customers that they should not delay purchase in the hopes of paying a lower price, our use of the MFC is a guarantee that the value of the rents generated by the input will not be eroded because of future sales.

While Coase's suggestion would solve the commitment problem in a simple model, it is easy to construct examples where MFCs and repurchase agreements are not equivalent. For instance, if there are many potential buyers, there is no guarantee that once the monopolist repurchased the input, he would resell it to the firm from whom it repurchased it. Such a threat could prevent a downstream firm from exercising the repurchase option in some situations. One could also consider situations in which there was the possibility of obsolescence of the durable or random fluctuations in demand. Clearly, MFCs and repurchase agreements have different risk-sharing implications. Finally, in a situation where the customer must perform maintenance on the durable that the seller cannot observe, a repurchase on demand agreement creates a morale hazard problem that the MFC does not.
supplier can capture all of the expected monopoly rents, it also suggests conditions under which the use of exclusivity clauses does not allow the supplier to capture maximal rents. For instance, if the producer were risk averse, then he would clearly be unwilling to pay the expected value of the rents generated in a market for exclusive rights to that market. Similarly, if the supplier had better information about the profitability of the market than did the producer, the producer would be unwilling to pay what the supplier claimed was the expected value of exclusive rights to the market.

To see how the use of MFCs can increase the supplier’s payoff, assume that producers are risk averse and that demand is random. In the low state, it is optimal for a monopoly producer to open one “outlet”; in the high state, it is optimal for a monopoly producer to open two outlets, and, as before, the randomness is resolved after at least one outlet is opened. Finally, assume that if one outlet is opened in the low state, it earns more than one of two outlets opened in the high state. In this case, the supplier can sell a producer the right to open one outlet for a price equal to the rents earned in the low state along with an MFC. This ensures that no further outlets are sold in the low state and that the supplier will sell the producer the right to open a second outlet in the high state for a price equal to the difference between the rents generated by two outlets in the high state and the rents generated by one outlet in the low state. Note that the risk averse producer earns a payoff of zero in each state of the world, so the supplier earns the full expected rents from this market.

The intuition from this discussion is interesting. It suggests that the use of MFCs can guarantee a producer a zero payoff in each state of the world so they can be used by a supplier to extract all of the expected rents from a given market even when producers are risk averse. A similar argument shows that MFCs can allow a supplier to extract all of the expected rents from a market when she has better information about the market than do the producers.

7. Conclusion

When selling a fixed input, a firm may face the problem of guaranteeing potential customers that she will not undertake actions in the future that will reduce the value of the input. One way to accomplish this is simply to grant the purchaser some form of exclusive right over the use of the input in a given market. We have argued that such a strategy by the seller can reduce the profits she can earn by foreclosing the possibility of exploiting future profitable opportunities.

In this paper we have suggested that a seller may wish to adopt
a different strategy. We have shown that when faced with a market setting in which noncontractable randomness affects the optimal number of units of an input to be sold, a seller can (or should) employ most favored customer clauses when selling the services of that input. Such a strategy allows the seller to guarantee the customer that she will not flood the market with additional units while preserving the ability to exploit profitable situations in the market should they arise. As we mentioned earlier, the ability to use such clauses depends on all parties’ ability to monitor secret price cuts.

The implication of our results for managerial behavior is simple. When a manager wishes to sell the rights to a durable input to a buyer who requires some guarantee that the market will not be flooded with these units in the future, a manager should employ a most favored customer clause as opposed to a simple exclusivity clause when the market contains noncontractable randomness.

APPENDIX A

PROOF OF PROPOSITION 1

The proof consists of a series of lemmas. Lemma 1 shows that there can be no perfect equilibrium in which more than \( j \) units are sold. Lemmas 2–4 lay the groundwork for Lemma 5, which shows that there can be no equilibrium in which less than \( j \) units are sold. Lemmas 6 and 7 show that there exists a perfect equilibrium in which \( j \) units are sold.

**Lemma 1:** There can be no perfect equilibrium in which more than \( j \) firms purchase the input.

**Proof.** Suppose \( j \) firms have purchased the input. The maximum any remaining firm would be willing to pay for the input is \( R_{j+1} \), because that is the most he can expect to earn in the final goods market. The minimum for which the supplier would be willing to sell a unit of the input is \( M \). Because \( R_{j+1} < M \), any strategy combination that involves the sale of the \( j + 1 \)st unit of the input must cause at least one of the players to earn a negative payoff from the transaction. Because each player can guarantee himself an incremental payoff of zero by not transacting, such a sale cannot occur in equilibrium.

**Lemma 2:** As part of any subgame perfect equilibrium, each firm will be willing to accept a price no greater than \( R_j \) when \( j - 1 \) firms have already purchased the input.
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Proof. Suppose \( j - 1 \) firms have purchased the input. Then, because each firm knows that at most one more unit of the input will be sold (Lemma 1), the minimum revenue that can be earned from purchasing the unit is \( R_j \). Because each remaining firm knows that he will receive at most one more offer, he would be willing to accept any price lower than \( R_j \) and earn a positive payoff as opposed to not buying the input and earning a zero payoff.

**Lemma 3:** There is no equilibrium in which the \( j \)th firm purchases the input for a price strictly less than \( R_j \).

**Proof.** Suppose the potential \( j \)th firm adopts a strategy of accepting any price strictly less than \( R_j \). Then there is no price, \( c_j' \), that the monopolist could offer that would be part of a perfect Nash equilibrium. If the supplier offered any price, \( c_j' \), there is some \( \epsilon > 0 \) such that the supplier could offer \( c_j' + \epsilon \) and improve his payoff by \( \epsilon \).

**Lemma 4:** If exactly \( j - 1 \) firms purchase the input, then the unique subgame perfect equilibrium of the subsequent subgame involves one more firm purchasing the input at a price of \( R_j \).

**Proof.** Suppose \( j - 1 \) firms have purchased the input. Lemma 2 has shown that the supplier can increase his payoff by offering some remaining firm a price in the half open interval \([M, R_j]\). Lemma 3 says that a subgame perfect continuation cannot involve the supplier offering a price less than \( R_j \). Because no other units will be sold (Lemma 1), neither the firm nor the supplier can improve his payoff by deviating from the strategy combination; the supplier offers a price of \( R_j \) and the firm accepts.

**Lemma 5:** There can never be a perfect equilibrium in which fewer than \( j \) firms purchase the input.

**Proof.** The proof employs backward induction using the intuition from Lemmas 2–4. Suppose there is a strategy combination in which \( j - 2 \) firms purchase the input. We know that if the \( j - 1 \)st unit is sold, then the \( j \)th unit will also be sold. Therefore, the most any firm will be willing to pay for the \( j - 1 \)st unit is \( R_j \). Because the supplier can increase his payoff by offering a firm any price in the interval \([M, R_j]\), exactly \( j - 2 \) units can never be sold in equilibrium. Further, from Lemma 3, the only subgame equilibrium continuation is for the supplier to sell the \( j - 1 \)st as well as the \( j \)th unit at a price of \( R_j \).

The same argument may be used to show that exactly \( j - 3 \) units can never be sold, exactly \( j - 4 \) units can never be sold, etc.
**Lemma 6:** There exists a subgame perfect Nash equilibrium in which each of \( j \) units is sold at a price equal to \( R_j \).

*Proof.* Consider the strategy combination in which (1) the supplier offers a price \( R_j \) and each producer accepts any price less than or equal to \( R_j \) if fewer than \( j \) units have been sold, and (2) the supplier offers a price, \( R_{j+1} \), and every producer accepts any price less than or equal to \( R_{j+1} \) if \( j \) units have been sold for all \( j > j \). Clearly, this is a Nash equilibrium because no player can unilaterally change his strategy and improve his payoff. (All firms receive a payoff of zero in equilibrium.) The fact that it is subgame perfect follows from Lemmas 2–4.

**Lemma 7:** In any subgame perfect equilibrium, all \( j \) units of the input must sell at a price of \( R_j \).

*Proof.* Clearly, a unit of the input could never sell for more than \( R_j \) because the firm that adopted a strategy that led to this transaction would earn a negative payoff. This firm could earn a zero payoff by adopting the strategy of never buying a unit of the input.

From Lemma 3, the \( j \)th unit cannot be sold at a price \( < R_j \). The use of a backward induction argument shows that no other unit can sell for a price \( < R_j \) as well. Assume the game has reached a node where \( j - 2 \) units have been sold. Assume also that the supplier has made offers in round \( j - 1 \) to all but one of the remaining \( n - (j - 2) \) firms, and each of these offers has been rejected. The best strategy for the firm that is about to receive an offer is to accept any offer \( \leq R_j \) (because we have shown that the \( j \)th unit will be sold once the \( j - 1 \)st unit is sold), and the supplier can do no better than to offer a price \( R_j \). \( \square \)

**Proof of Proposition 3**

The strategy combination in which every downstream firm accepts any price \( \leq R_j \) and the supplier offers \( R_j \) to the first \( j^* \) producers along with an MFC is a Nash equilibrium.

Assume that the supplier has sold \( j^* \) units of the input at a price of \( R_j \). Because \( j^* R_j < j^* R_j \) for \( j^* < j^* < j^* \leq n \), we know that the supplier earns a higher payoff by selling \( j^* \) units at a price of \( R_j \) than she can by selling \( j^* \) units at a price of \( R_j \) for \( j^* > j^* \). Because in equilibrium no producer will purchase a unit at a price such that they will earn a negative payoff, the supplier can never earn a revenue higher than \( j^* R_j \) from selling \( j^* \) units. Hence, once \( j^* \) units are sold at a price of \( R_j \) with an MFC, no further transactions would occur in a subgame perfect continuation.

Now note that if \( j^* - 1 \) units are sold for a price of \( R_j \) then the
$j^\text{th}$ unit is sold for a price of $R_j^*$ as well. Similarly if $j^* - 2$ units are sold at a price of $R_j$, then the $j^* - 1$st will be sold at a price of $R_j^*$. A standard induction argument can show that all previous units will also be sold at a price of $R_j^*$.  \( \square \)

APPENDIX B

\textbf{Example: Random Producer Type}

Consider a game played between three producers and the supplier. There are two types of producers, innovators and clones. Innovators develop differentiated products and compete based on this differentiation. Clones on the other hand duplicate lower-quality copies of final goods produced by innovators and compete on price.

Let $R_{ij}$ be the yearly revenue generated by an innovator when there are $j$ producers competing and they are all innovators. Let $R_{jc}$ be the yearly revenue earned by an innovator when $n$ producers compete, and one of them is a clone. Finally let $R_c$ be the yearly revenue earned by a clone. (Clones’ earnings are independent of the number of innovators and could be thought of as “close to” the market rate of return.)

We assume that innovators must sink $S$ in order to participate in the market, but clones need not.

We will assume that:

A2.1. $2R_{ij}/r - 2S > R_{ij}/r - S$
A2.2. $R_{jc} < R_{ij}$
A2.3. $jR_{ij}/r - jS > jR_{ij}/r - jS + R_c$
A2.4. $R_{jc} > 0$

A2.1 says that the final goods market generates more rents with two innovators competing than with one (Again, think of network externalities or differential access to market segments.) A2.2 says an innovator would rather be a monopolist than compete against a clone. A2.3 says that the total rents generated in the final goods market always go down when a clone enters. A2.4 says net revenues are positive when a clone enters.

The timing of events is as follows. At time zero there are two producers. Producer 1 is known to be an innovator and producer 2 is known to be a clone. At time $t$, producer 3 will enter. With probability $\rho$, producer 3 is a clone, and with probability $(1 - \rho)$ he is an innovator. Producer 3 knows his type, but this information cannot be revealed credibly to any other players before he purchases the input.

At time 0 the supplier can make sequential take-it-or-leave-it
offers to producers 1 and 2 in the manner described in the previous example. At time $t$ the supplier can make offers to producer 3 and any other producer that has not yet purchased a unit of the input. As before, because the length of $t$ has no qualitative effect on the equilibrium, we can without loss of generality assume that $t = 0$. We must simply retain the assumption that the supplier makes an offer to producer 1 before she makes an offer to producer 3.

All players are expected profit maximizers, and their payoffs are (as in the previous game) the profits they receive from their participation in the market.

Again we look at the subgame equilibria of two games: one with exclusivity clauses and one with MFCs. We show that the use of MFCs dominates the use of exclusivity clauses. Specifically, when the ability of a second competitor to increase industry profitability is an ex ante unobservable random variable, the supplier earns more by selling the input using MFCs than she does by using exclusivity clauses or short-term leases.

**Equilibrium Using Exclusivity Clauses**

If the supplier granted producer 1 an exclusivity clause, she could sell the input for a price of $R_{1i}/r - S$. This is her expected payoff.

If the supplier wrote a clause that stated that two units of the input would be sold, she could first sell one unit to producer 1 for a price of $\rho R_{2k} + (1 - \rho)(R_{3i})/r - S$. Next, she would offer the good to the clone at a price of $\infty$, which would be rejected. She would then offer the input to producer 3 at a price of $R_{3i} - S$. If he accepts, she is done making offers. If he rejects, then she makes an offer to producer 2 at a price of $R_{2}/r$, which he accepts. Notice that the only Nash equilibrium of this game involves producer 3 accepting the offer if he is an innovator and rejecting the offer if he is a clone.

Hence, if the supplier writes an exclusivity clause allowing two units of the input to be sold, she earns an expected payoff of $[\rho R_{2k} + R_{2i} + (1 - \rho)(2R_{3i})]/r - (2 - \rho)S$ in this game. As in example 1, which exclusivity clause she offers depends on the relative magnitudes of $R_{1i}/r - S$ and $[\rho R_{2k} + R_{2i} + (1 - \rho)(2R_{3i})]/r - (2 - \rho)S$.

**Equilibrium Using MFCs**

In the game with the MFC there are again two cases:

**Case 1:** $R_{1i} > R_{2i}$

The supplier begins by offering producer 1 a price of $R_{1i}/r - S$ along with an MFC. Next she offers producer 2 a price of $\infty$, which is re-
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It Strategy

If producer 3 rejects the offer, she makes no more offers. The supplier’s expected payoff is 
\[ \rho R_{11} + (1 - \rho)2R_{21} - (2 - \rho)S. \]

**Case 2: \( R_{11} < R_{21} \)**

The supplier starts by offering producer 1 a price of \[ \frac{\rho R_{11} + (1 - \rho)R_{21}}{r} - S \] along with an MFC, which is accepted. Next she offers producer 2 a price of \( \infty \), which is rejected. Then she offers producer 3 a price of \( \frac{R_{21}}{r} - S \), which is accepted. Again the supplier’s payoff is \[ \rho R_{11} + (1 - \rho)2R_{21} - (2 - \rho)S. \]

A comparison of the equilibrium payoffs from using exclusivity clauses and the payoffs from using MFCs reveals that once again the supplier earns more from using MFCs. In case 1 and in case 2, \[ \rho R_{11} + (1 - \rho)2R_{21} - (2 - \rho)S > \max \{ R_{11} - S, \rho(R_{21} + R_{1}) + (1 - \rho)(2R_{21}) - (2 - \rho)S \} \]

The intuition behind this result is very similar to that of example 1. Again the MFC allows the supplier to sell the optimal number of units in each state of the world. In this model the main purpose of the MFC is to make it unprofitable for the supplier to sell to clones. A second role for MFCs in case 1 is to protect producer 1 from the event that producer 3 is an innovator, which lowers producer 1’s revenue.

**References**


