# Nondiscrimination Clauses in Vertical Contracts

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May 2002
Duke/UNC Micro-Theory Working Paper #14

**Abstract**

In their seminal article on multilateral vertical contracting, McAfee and Schwartz (1994) argue that nondiscrimination clauses may be ineffective in curbing opportunism and may thus have no bite. This begs the question why nondiscrimination clauses are commonly observed in intermediate-goods markets. In this note, we show that nondiscrimination clauses alter the monopolist's incentives and thus affect equilibrium payoffs even if they do not support equilibria in which all firms are offered the joint-profit-maximizing contract.

**JEL Classification Codes**: D43, D45, L14, L42

**Keywords**: Most-favored customer clauses, best-price provisions

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# 1 Introduction

Nondiscrimination clauses make a seller's best terms available to all buyers.[1] Despite the fact that these clauses are commonly observed in intermediate-goods markets, most of the literature focuses on their use in final-goods markets.[2] This is problematic because McAfee and Schwartz (1994) have shown that the insights derived in this literature may not apply to situations in which buyers compete. For example, in his article on best-price provisions, Butz (1990) shows that a monopolist can solve the well-known dynamic inconsistency problem in durable-goods markets by offering to give rebates to early buyers if it subsequently lowers its price. Although one might think that nondiscrimination clauses can play a similar role in intermediate-goods markets when the contracting is sequential, McAfee and Schwartz show otherwise.

McAfee and Schwartz show in a model of sequential contracting with one seller and $n$ downstream firms that when the joint-profit-maximizing contract is in place with the first $n-1$ firms, the monopolist and $n^{\text{th}}$ firm have the *same* incentive to behave opportunistically whether or not the first $n-1$ firms have nondiscrimination clauses. They conclude that nondiscrimination clauses will generally be ineffective in curbing seller opportunism and thus may have no bite. This is a negative result in that it begs the question why these clauses are commonly observed. In this note, we show that nondiscrimination clauses do have real effects in McAfee and Schwartz's model because they alter incentives and affect equilibrium payoffs even if they do not support equilibria in which all firms are offered the joint-profit-maximizing contract.

# 2 Model

Suppose an upstream monopolist supplies inputs to $n \geq 2$ potential downstream firms that use the inputs to produce substitute products. Suppose the monopolist can make

[1] These clauses are also known as most-favored-customer clauses or best-price provisions.

[2] See, e.g., Besanko and Lyon (1993), Cooper (1986), Neilson and Winter (1993), Schnitzer (1994).

take-it-or-leave-it offers. Denote the monopolist's offer to firm $i$ as the pair $(r_i, f_i)$, where $r_i$ is the wholesale price of the input and $f_i$ is a fixed fee. The monopolist produces at constant marginal cost $z \geq 0$ and has no fixed cost.

As in McAfee and Schwartz, we capture a situation in which the monopolist cannot commit at the outset to all contracts by supposing that the monopolist approaches firms $1, ..., n$ in sequence. At each step in the sequence, a firm either accepts or rejects its offer, having observed all prior offers and decisions. If it rejects the offer, it earns zero. If it accepts the offer, it spends $k > 0$ on relationship-specific investments ($k$ is sunk once incurred). After this stage is completed, firms that have accepted contracts learn of all offers and decisions. A firm can then either exit or participate in the product market. If a firm exits, its continuation payoff is zero, but it loses its sunk cost $k$. Otherwise, it competes in the product market under the terms of its accepted contract.

We assume the product market equilibrium is unique for any distribution of wholesale prices $\mathbf{r} = (r_1, ..., r_n)$ in which all $n$ firms are active, with firm $i$'s equilibrium flow payoff given by $\pi_i(\mathbf{r})$. For $r_i$ sufficiently large, firm $i$'s flow payoff is zero. Otherwise, if firms $i$ and $j$ are both active, we assume that $\pi_i$ is decreasing in $r_i$ and increasing in $r_j$ for $i \neq j$, so that a firm's flow payoff is decreasing in its own wholesale price and increasing in the wholesale price of a competitor. We also assume

$$\frac{\partial^2 \pi_i(r_1, ..., r_n)}{\partial r_i \partial r_j} < 0, \tag{1}$$

which implies that firm $i$'s flow payoff is less sensitive to a decrease in its own wholesale price (does not increase as much) the lower is the wholesale price of a competitor.

Let $q_i(\mathbf{r})$ denote firm $i$'s equilibrium input demand as a function of the wholesale prices. Then the monopolist's flow payoff is $\sum_{i=1}^{n}(r_i - z)q_i(\mathbf{r})$ and, assuming all $n$ firms are active, the overall joint payoff of the monopolist and $n$ downstream firms is

$$\Pi(\mathbf{r}) \equiv \sum_{i=1}^{n}(r_i - z)q_i(\mathbf{r}) + \sum_{i=1}^{n}(\pi_i(\mathbf{r}) - k)\,.$$

Let $u_i(\mathbf{r})$ be the joint payoff of the monopolist and firm $i$ excluding fixed fees:

$$u_i(\mathbf{r}) \equiv \Pi(\mathbf{r}) - \sum_{j \neq i} \left(\pi_j(\mathbf{r}) - k\right).$$

We assume $\Pi(\mathbf{r})$ and $u_i(\mathbf{r})$ are twice differentiable, concave in $r_i$, and have the property that own price effects dominate cross price effects, i.e., $\left|\frac{\partial^2 \Pi}{\partial r_i^2}\right| > \left|\frac{\partial^2 \Pi}{\partial r_i \partial r_j}\right|$ and $\left|\frac{\partial^2 u_i}{\partial r_i^2}\right| > \left|\frac{\partial^2 u_i}{\partial r_i \partial r_j}\right|$ for $j \neq i$. We also assume the downstream firms are symmetric, i.e., given $\mathbf{r}'$ and $\mathbf{r}''$, where $r_i'' = r_j'$, $r_j'' = r_i'$, and $r_l'' = r_l'$ for $l \notin \{i, j\}$, then $\pi_i(\mathbf{r}') = \pi_j(\mathbf{r}'')$.

Let $r^* \equiv \arg\max_{r \geq 0} \Pi(r, ..., r)$, so $\Pi(r^*, ..., r^*)$ is the maximum overall joint payoff.[3] If the equilibrium outcome is such that all $n$ downstream firms operate under a contract with wholesale price $r^*$, then overall joint payoff is maximized.

Let $\hat{r}_n(\mathbf{r}_{-n}; \mathbf{f}_{-n})$ be the wholesale price that maximizes the joint payoff of the monopolist and firm $n$ given the wholesale prices and fixed fees for the other $n-1$ downstream firms (assuming they are active), i.e.,

$$\hat{r}_n(\mathbf{r}_{-n}; \mathbf{f}_{-n}) \in \arg\max_{r \geq 0} u_n(\mathbf{r}_{-n}, r) + \sum_{i=1}^{n-1} f_i \tag{2}$$

subject to the participation constraints:

$$\pi_i(\mathbf{r}_{-n}, r) - f_i \geq 0 \text{ for } i \neq n. \tag{3}$$

If there were no sunk costs, each firm would accept the monopolist's offer of $(r^*, f^*)$, where $f^* \equiv \pi(r^*, ..., r^*) - k$,[4] and overall joint payoff would be maximized. However, because of the sunk costs, McAfee and Schwartz show that this outcome cannot be achieved. This is because if the first $n-1$ firms all have the contract $(r^*, f^*)$, then the profit-maximizing wholesale price to the last firm is less than $r^*$, i.e., $\hat{r}_n(r^*; f^*) < r^*$ (where we abuse notation by using $\hat{r}_n(r'; f')$ in place of $\hat{r}_n(r', ..., r'; f', ..., f')$ to denote the optimal wholesale price when all the other $n-1$ firms have the same contract $(r', f')$). This follows from the concavity of $u_i$ since

$$\frac{\partial u_n(r^*, ..., r^*)}{\partial r_n} = \frac{\partial \Pi(r^*, ..., r^*)}{\partial r_n} - \sum_{j \neq n} \frac{\partial \pi_j(r^*, ..., r^*)}{\partial r_n} < 0, \tag{4}$$

[3] Our assumptions imply that $\Pi(r, ..., r)$ is concave and thus $\arg\max_{r \geq 0} \Pi(r, ..., r)$ is unique.

[4] Symmetry allows us to drop the subscript on $\pi$ when all firms have a common wholesale price.

where $\frac{\partial \Pi(r^*,...,r^*)}{\partial r_n} = 0$ by the definition of $r^*$ and $\sum_{j \neq n} \frac{\partial \pi_j(r^*,...,r^*)}{\partial r_n} > 0$ because each firm's flow payoff is increasing in the wholesale price of an active competitor.

Thus, it cannot be an equilibrium for the monopolist to offer the contract $(r^*, f^*)$ to all downstream firms because it can earn higher payoff by lowering the last firm's wholesale price and raising its fixed fee to extract the extra surplus: $f_n > f^*$, where $f_n \equiv \pi_n(r^*, ..., r^*, \hat{r}_n(r^*; f^*)) - k$. As McAfee and Schwartz (p. 215) note, the monopolist ignores the reduction in the first $n-1$ firms' profits from cutting price to the last firm, an effect internalized when computing $r^*$. Ultimately, however, the monopolist loses because in a subgame-perfect equilibrium, the first $n-1$ firms will anticipate the monopolist's incentive for opportunism and adjust their accept or reject decisions accordingly.

One might think that this opportunism could be thwarted by giving the first $n-1$ firms a nondiscrimination clause along with the contract $(r^*, f^*)$, where a nondiscrimination clause gives each firm the right to replace its initially accepted contract with any other contract offered to and accepted by another firm prior to competing in the product market. However, McAfee and Schwartz show otherwise. They show that the monopolist would still have an incentive to cut its wholesale price to the last firm, and, in fact, the opportunistic wholesale price would be *unchanged*.[5]

McAfee and Schwartz (p. 217) interpret this result as implying that nondiscrimination clauses will generally be ineffective in curbing the monopolist's opportunism. They note that, "Nondiscrimination clauses may thus have no bite—because only one firm will accept a deviation contract that offers a low marginal cost, provided the average cost is sufficiently high; other firms will elect not to exercise the option

[5]To see this, note that firm 1's payoff if it does not invoke its nondiscrimination clause is $\pi_1(r^*, r_2, ..., r_{n-1}, \hat{r}_n(r^*; f^*)) - \pi_1(r^*, ..., r^*) < 0$, where $r_i \in \{r^*, \hat{r}(r^*; f^*)\}$ for $i \in \{2, ..., n-1\}$, whereas firm 1's payoff if it does invoke its nondiscrimination clause is $\pi_1(\hat{r}_n(r^*; f^*), r_2, ..., r_{n-1}, \hat{r}_n(r^*; f^*))) - \pi_1(\hat{r}_n(r^*; f^*), r^*, ..., r^*) < 0$. In both cases firm 1's net payoff is negative. But because the cross-partial derivatives of $\pi_1$ are negative, firm 1's payoff in the latter case is strictly lower. Firm 1 does not invoke its nondiscrimination clause because although it would benefit from having a lower wholesale price, it is not willing to pay the higher fixed fee. Similarly, one can show that firms $2, ..., n-1$ also do not want to invoke their nondiscrimination clauses.

of exchanging their contracts for this new contract."

## 3 Nondiscrimination clauses matter

To show that nondiscrimination clauses can have real effects even when they are not invoked, we begin by defining what it means for a set of contracts, one for each firm, to be *pairwise-proof.* We follow the definition in McAfee and Schwartz (p. 216).

**Definition 1** The vector of wholesale prices $\mathbf{r}^p$ is *pairwise-proof* if for all $i \in \{1, ..., n\}$, $r_i^p \in \arg\max_{r_i \geq 0} u_i(r_1^p, ..., r_{i-1}^p, r_i, r_{i+1}^p, ..., r_n^p)$.

If the vector of wholesale prices is pairwise-proof, then the monopolist maximizes its joint payoff with each firm, given the contracts of the other $n-1$ firms. Symmetry implies that the wholesale prices in any pairwise-proof vector must be the same for each firm. If $r^p$ is the (assumed unique) pairwise-proof wholesale price, then $\frac{\partial u_n(r^p,...,r^p)}{\partial r_n} = 0$ and, by our assumptions on $\Pi$, $r^p < r^*$.[6] Letting $f^p \equiv \pi(r^p, ..., r^p) - k$, it follows that $\hat{r}_n(r^p; f^p) = r^p$. Thus, if the first $n-1$ firms have the contract $(r^p, f^p)$, then the monopolist can do no better than to offer the last firm the contract $(r^p, f^p)$.

We can now identify a key characteristic of the equilibrium of the game without nondiscrimination clauses—not all firms are offered the same wholesale price.

**Lemma 1** *In any equilibrium of the game without nondiscrimination clauses, the downstream firms earn zero payoff and their wholesale prices are asymmetric.*

*Proof.* See the Appendix.

To understand this result, note that if the wholesale prices were symmetric, then they would have to be pairwise-proof,[7] and then the monopolist would not want to

[6] To see this, note that $\frac{\partial u_n(r^p,...,r^p)}{\partial r_n} = 0$ implies that $\frac{\partial \Pi(r^p,...,r^p)}{\partial r_n} > 0$, which implies that $r^p < r^*$.

[7] This follows because the contract offer to firm $i$ that maximizes the monopolist's payoff is the same as the contract offer that maximizes the joint payoff of the monopolist and firm $i$.

offer a different contract to the $n^{\text{th}}$ firm. But consider its wholesale price offer to the second-to-last firm, which is chosen to maximize the joint payoff of the monopolist and firm $n-1$ given the first $n-2$ contracts and given that firm $n$'s contract will be chosen opportunistically. Because the opportunistic behavior with firm $n$ is taken into account in choosing the $n-1^{\text{st}}$ firm's contract, the optimization problem is affected. Instead of choosing $r_{n-1}$ to maximize $u_{n-1}(r^p,...,r^p,r_{n-1},r^p)+(n-1)f^p$ subject to the participation constraints, the monopolist chooses $r_{n-1}$ to maximize

$$\begin{aligned}&u_{n-1}\left(r^p,...,r^p,r_{n-1},\hat{r}_n(r^p,...,r^p,r_{n-1};f^p,...,f^p,f_{n-1})\right)+\\&(n-2)f^p+\pi_n\left(r^p,...,r^p,r_{n-1},\hat{r}_n(r^p,...,r^p,r_{n-1};f^p,...,f^p,f_{n-1})\right)-k,\end{aligned}$$

subject to the participation constraints. This implies that $r_{n-1}$ will differ from $r^p$.

Let the game with nondiscrimination clauses be defined similarly to the game without nondiscrimination clauses except, in addition to being offered the pair $(r_i,f_i)$, firm $i$, $i\in\{1,...n\}$, is also offered a nondiscrimination clause. We can now identify the key characteristics of the game with nondiscrimination clauses—either some downstream firms earn positive payoff or their wholesale prices are symmetric.

**Lemma 2** *In any equilibrium of the game with nondiscrimination clauses, either some downstream firms earn positive payoff or their wholesale prices are symmetric.*

*Proof.* Let $\mathbf{r}'$ be the equilibrium wholesale prices faced by the downstream firms after all firms have had an opportunity to invoke their nondiscrimination clauses. Suppose no downstream firm earns positive payoff. Then it must be that the fixed fees are $f_i'\equiv\pi_i(\mathbf{r}')-k$ for all $i\in\{1,...,n\}$. Suppose also that the equilibrium is asymmetric with $r_i'>r_j'$. Define $\tilde{\pi}_i(r_i,r_j)$ and $\tilde{\pi}_j(r_i,r_j)$ to be firm $i$ and $j$'s flow payoffs given wholesale prices $r_i$ and $r_j$ for firms $i$ and $j$ and wholesale prices as in $\mathbf{r}'$ for firms other than $i$ and $j$. Since firm $j$ (the firm with the lower wholesale price) did not use its nondiscrimination clause to obtain firm $i$'s wholesale price, it must be that

$$\tilde{\pi}_j(r_i',r_j')-f_j'\geq\tilde{\pi}_j(r_i',r_i')-f_i'.$$

Substituting in for $f_i'$ and $f_j'$ and using symmetry, we get

$$0 \geq \tilde{\pi}_i(r_i', r_i') - \tilde{\pi}_i(r_i', r_j'),$$

which implies, because $\tilde{\pi}_i$ is increasing in $r_j$, that $r_i' \leq r_j'$, a contradiction. Q.E.D.

To understand this result, recall that if each firm's payoff is zero and two firms are offered different wholesale prices, then the firm with the higher wholesale price and lower fixed fee does not want to use its nondiscrimination clause to obtain the contract with the lower wholesale price and higher fixed fee. However, the flip side of this is that the firm with the lower wholesale price and higher fixed fee *would* want to operate under the contract with the higher wholesale price and lower fixed fee, and thus *would* want to invoke its nondiscrimination clause. Thus, in the game with nondiscrimination clauses, the final wholesale prices, after all firms have had an opportunity to invoke their nondiscrimination clauses, cannot be different in equilibrium.

Lemma 2 implies that the wholesale prices faced by the downstream firms are symmetric in the game with nondiscrimination clauses (if they earn zero payoff). Lemma 1 implies that the wholesale prices faced by the downstream firms are asymmetric in the game without nondiscrimination clauses. Since the downstream firms earn zero payoff in this latter game, these two lemmas prove the following proposition.

**Proposition 1** *Nondiscrimination clauses affect equilibrium outcomes. Either they give downstream firms positive payoff in equilibrium or they result in wholesale prices (and hence retail prices) that differ from those that would arise in their absence.*

Proposition 1 implies that nondiscrimination clauses have bite, despite claims to the contrary in the literature. Although they cannot support an equilibrium in which all firms are offered the joint-profit-maximizing contract, it is incorrect to suggest that they would have no effect on equilibrium outcomes. It remains to show, of course, how large this effect can be and thus our result is best seen as a first step towards understanding why nondiscrimination clauses may be observed in these markets.

# 4 Conclusion

Nondiscrimination clauses are commonly observed in intermediate goods markets, and the list of firms using them include some of the largest companies in the world. Yet despite their importance there is little understanding of the role of nondiscrimination clauses in these markets. Indeed, previous literature suggests that nondiscrimination clauses will be ineffective in curbing opportunism and may thus have no bite. Our results suggest otherwise. Although it is true that an early firm may not want to invoke its nondiscrimination clause to obtain a later firm's lower wholesale price if it must also pay the later firm's higher fixed fee, it is also true (from the same assumption on cross-partial profit derivatives) that in these same circumstances a later firm *would* want to invoke its nondiscrimination clause to obtain an early firm's higher wholesale price and lower fixed fee. Thus, nondiscrimination clauses will tend to force outcomes towards symmetry even when the contracting occurs sequentially.

# A Appendix

*Proof of Lemma* 1. Suppose there is an equilibrium $(\mathbf{r}, \mathbf{f})$ in which firm $i$ has positive payoff. Then $\pi_i(\mathbf{r}) - f_i - k > 0$. In this case, the monopolist can profitably deviate by offering the same contracts except a slightly higher fixed fee for firm $i$. All participation constraints continue to be met and the quantity choices in the downstream market are the same, but the monopolist's payoff increases. Thus, all downstream firms earn zero payoff in any equilibrium.

Suppose the equilibrium is symmetric. Let $(r^b, f^b)$ be the common equilibrium contract. Then $f^b = \pi(r^b, ..., r^b) - k$. Because $r_n = r^b$, it follows that $\hat{r}_n(r^b; f^b) = r^b$ and $\frac{\partial u_n(r^b,...,r^b)}{\partial r_n} = 0$, which with symmetry implies that $r^b$ is pairwise-proof. Since $r_{n-1} = r^b$, it follows that $r^b$ solves

$$\begin{aligned} \max_{r_{n-1}\geq 0} \quad & u_{n-1}\left(r^b, ..., r^b, r_{n-1}, \hat{r}_n(r^b, ..., r^b, r_{n-1}; f^b, ..., f^b, f_{n-1})\right) \\ & + \textstyle\sum_{i=1}^{n-2} f^b + \pi_n\left(r^b, ..., r^b, r_{n-1}, \hat{r}_n(r^b, ..., r^b, r_{n-1}; f^b, ..., f^b, f_{n-1})\right). \end{aligned}$$

Since $\frac{\partial u_{n-1}\left(r^b,...,r^b\right)}{\partial r_{n-1}} = 0$, the first-order condition for $r_{n-1}$ implies that

$$\left(\frac{\partial u_{n-1}\left(r^b, ..., r^b\right)}{\partial r_n} + \frac{\partial \pi_n\left(r^b, ..., r^b\right)}{\partial r_n}\right)\frac{\partial \hat{r}_n(r^b; f^b)}{\partial r_{n-1}} + \frac{\partial \pi_n\left(r^b, ..., r^b\right)}{\partial r_{n-1}} = 0. \tag{A.1}$$

Using $\frac{\partial u_n(r^b,...,r^b)}{\partial r_n} = 0$ and the definition of $u_n$,

$$\sum_{i=1}^{n}(r^b - z)\frac{\partial q_i(r^b, ..., r^b)}{\partial r_n} + q_n(r^b, ..., r^b) + \frac{\partial \pi_n(r^b, ..., r^b)}{\partial r_n} = 0. \tag{A.2}$$

Then, using (A.2) and the definition of $u_{n-1}$,

$$\begin{aligned} \frac{\partial u_{n-1}\left(r^b,...,r^b\right)}{\partial r_n} + \frac{\partial \pi_n\left(r^b,...,r^b\right)}{\partial r_n} &= \frac{\partial u_{n-1}\left(r^b,...,r^b\right)}{\partial r_n} - \textstyle\sum_{i=1}^{n}(r^b - z)\frac{\partial q_i(r^b,...,r^b)}{\partial r_n} - q_n(r^b, ..., r^b) \\ &= \frac{\partial \pi_{n-1}\left(r^b,...,r^b\right)}{\partial r_n} \\ &= \frac{\partial \pi_n\left(r^b,...,r^b\right)}{\partial r_{n-1}}. \end{aligned}$$

Thus, (A.1) can be rewritten as $\frac{\partial \pi_n\left(r^b,...,r^b\right)}{\partial r_{n-1}}\left(\frac{\partial \hat{r}_n(r^b;f^b)}{\partial r_{n-1}} + 1\right) = 0$, a contradiction since $\frac{\partial \pi_n\left(r^b,...,r^b\right)}{\partial r_{n-1}} > 0$ and since $\left|\frac{\partial^2 u_i}{\partial r_i^2}\right| > \left|\frac{\partial^2 u_i}{\partial r_i \partial r_j}\right|$ implies $\frac{\partial \hat{r}_n(r^b;f^b)}{\partial r_{n-1}} \neq -1$. Q.E.D.

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