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Evaluating the 'Leverage Theory' of Product Bundling in the Context of Negotiations

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Abstract

I have developed a model to evaluate the leverage theory of product bundling in the context of negotiations between a monopolist and intermediaries who sell its products to consumers. I investigated whether the monopolist finds it feasible and advantageous to utilize product bundling in order to block negotiations between the intermediaries and a rival firm who competes against the monopolist in a complementary market. My results support the Chicago School conventional wisdom that product bundling is ineffective in extending monopoly power, even in this modified environment where it affects the bargaining position of the monopolist in negotiations with powerful business partners. Specifically, the monopolist finds foreclosure of competitors via bundling either unprofitable or not feasible.

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1. Introduction

According to the leverage theory, product bundling is viewed as a mechanism that enables a firm with monopoly power in one market to leverage this power in order to foreclose sales and thereby monopolize a second market. The Chicago School critic of the traditional leverage theory typically assumes that the second market is perfectly competitive. The monopolist is unable, therefore, to extract surplus from the second market, and hence cannot benefit from foreclosure through bundling (see Director and Levi (1956), Bowman (1957), Posner (1967), and Bork (1978).) The "new foreclosure theory" allows for imperfect competition in the second market (see Aghion and Bolton (1987), Hart and Tirole (1990), Whinston (1990), and Rasmusen et-al (1991).) It demonstrates that with such imperfect competition, circumstances may arise under which a monopolist can utilize bundling of complementary products in order to preserve and extend its monopoly position. The underlying assumption of the "new theory" as well as of product bundling as a price discrimination device (Stigler (1968), Adams and Yellen (1976), Schmalensee (1982,1984) and McAfee, McMillan and Whinston (1984),) has been that the monopolist sells its products directly to powerless, price taking consumers. However, in many markets where bundling has been prevalent firms do not necessarily sell their products to powerless consumers. Two examples of such markets include the software industry where Microsoft has bundled Internet Explorer as part of Windows and health care markets where bundling has taken the form of acquisition of physician practices by hospitals.

In the software industry, Microsoft rarely sells its operating system directly to consumers. Because of the technical difficulties of installing the software, most consumers expect computer manufacturers to sell their machines with the operating system already installed. As a result, Microsoft has to negotiate licensing agreements with computer manufacturers who serve as intermediaries between the software giant and consumers. Those manufacturers, in turn are not necessarily powerless, price taking entities and include companies such as Compaq, IBM or Dell.

Similarly, in health care markets even hospitals with significant market power do not charge patients directly for the services they provide. Instead they have to negotiate terms of reimbursement with large and powerful health insurers and HMO's. To test the leverage theory in the context of the above examples or in any other market where a monopolist negotiates terms of trade with powerful customers, it is important to explicitly capture the negotiations process in

order to identify the bargaining position of each of the parties involved. In the present paper I develop such a negotiation based model to investigate whether a monopolist can extend its monopoly position via product bundling when it sells its products indirectly to consumers through intermediaries.

In my model a monopolist (Firm 1) in one market (Market A) competes against another firm (Firm 2) in a complementary market (Market B). The competing products in Market B are perceived to be differentiated by consumers. Efficiency dictates that the products of the monopolist and its competitor are sold through intermediaries who also possess some market power. I capture this power by assuming that there are only two intermediaries who are considered to be differentiated from the perspective of consumers. The extent of differentiation between the intermediaries determines the strength of their negotiating position vis-a-vis the firms. In my analysis, I investigate whether by bundling its products together the monopolist can block the negotiations between the intermediaries and Firm 2 and by doing so, leverage its monopoly position from Market A to Market B. My results support the Chicago School conventional wisdom that product bundling cannot serve as a successful device in extending monopoly power. Specifically, when the market is completely covered so that the entire population of consumers participate in it and when the degree of differentiation between the intermediaries is relatively small, the monopolist never finds it profitable to bundle its products together in order to block the negotiations with its competitor, Firm 2. Since the intermediaries compete intensely for consumers in this case the monopolist can utilize its monopoly position in Market A to extract a large share of the surplus generated in the negotiations with the intermediaries. This surplus is higher, in turn if consumers have the freedom to choose the brand of product B that they prefer best. Sabotaging the negotiations between Firm 2 and the intermediaries is counterproductive therefore, from the perspective of the monopolist. When a segment of the population of consumers refrains from consumption or when the degree of differentiation between the intermediaries is relatively high, each intermediary has a stronger bargaining position in the negotiations with the monopolist. With a significant share of the surplus now accruing to the intermediaries in the negotiation, each has an incentive to increase the willingness to pay of its customers. Providing customers freedom of choice among the brands of product B increases indeed, this willingness to pay. Hence, even when the monopolist bundles its two products

together the intermediaries still find it optimal to reach an agreement with Firm 2 as well. Given that foreclosure via bundling is either unprofitable to the monopolist or not feasible, the present model tends to support the view that product bundling cannot extend monopoly power.

Two main features of my model yield the different result from that obtained in the "new leverage theory". First, the assumption that the monopolist and its competitor produce differentiated goods in the second market implies that there is an increase in total surplus (or efficiency gain) if the two different brands are offered for sale in the second market. Second, when the goods are sold through intermediaries the monopolist can extract a significant portion of this added surplus from the intermediaries because of its power in the monopoly good. The monopolist has reduced incentives, therefore to prevent the intermediaries from dealing with its competitor in the second market. In contrast, when the goods are sold directly to final consumers, as is assumed in the existing literature, there is no such mechanism for the monopolist to extract the added surplus generated in the second market, and foreclosure can be desirable as a result.

The main contribution of the present analysis is in identifying an important circumstance where a monopolist cannot profitably bundle its product with a second market to exclude its rivals there. I think this contribution is important for at least two reasons. First, from a theoretical perspective, this clarifies the role of negotiations with intermediaries in reversing the leverage theory. Second, since product bundling by firms who sell their products through intermediaries has resulted in significant anti-trust concerns, the findings in this paper have profound policy implications.

For the sake of concreteness I formulate the model in the context of the Department of Justice's case against Microsoft. The identities of the firms and intermediaries in this context are Microsoft, Netscape, and the computer manufacturers, who when selling their computers bundled with the operating system serve as intermediaries between the software producers and consumers. Markets A and B, in this context are the operating systems and browsers markets, respectively. While my focus on the leverage theory of product bundling relates directly to some of the accusations of the Justice Department against Microsoft, my model can be only of limited use in this context. Specifically, it does not address a major complaint of the Department of Justice that foreclosing the browsers market may have actually been intended to protect Microsoft's monopoly position in the operating systems market (by preventing the distribution of a Universal Java

System). Since in my model the monopolist is never threatened in Market A, I cannot address this possible motivation for market foreclosure. However, recent theoretical findings (Chen (1998)) demonstrate it to be unlikely that Microsoft might have wanted to foreclose the Browsers market in order to protect its monopoly position in the systems market. According to the paper, when goods are strategic complements, a monopolist facing entry threat will win the bidding for a new market anyway, even in the absence of bundling. Moreover, if due to technical deficiencies, the future prospects of the Universal Java System were in doubt irrespective of the actions taken by Microsoft (see Wall Street Journal articles on 12/4/98, and 2/1/99 or in the Portland Oregonian on 12/4/98), then Netscape's browser never really posed any serious threat to Microsoft's monopoly position in the operating systems market. The results of the present analysis tend to support, therefore, Microsoft's contention that bundling Internet Explorer as part of Windows has been motivated by enhancing convenience of use and not the foreclosure of Netscape from the market.

While having some applicability to the Department of Justice case against Microsoft, I do not consider this feature to be the main contribution of the present analysis. Rather, the paper attempts to evaluate in general the leverage theory of product bundling in the context of negotiations among powerful business partners. If in the computer industry these partners are software producers and computer manufacturers, in health care markets the negotiating partners are hospitals and insurers. The results of my analysis apply to the latter example as well since in many hospital markets, where vertical mergers between hospitals and physician practices have taken place, the merging hospital had significant market power due to a local monopoly (University of Pittsburgh Medical Center in western Pennsylvania, for instance). A concern has been raised as to whether by bundling its services with those of the acquired physicians the hospital attempts to extend its monopoly position to the physicians market as well. The existing literature on the leverage theory cannot evaluate this concern adequately since it fails to capture the negotiation process between hospitals and insurers. The negotiation based model that I develop offers a vehicle to conduct such an evaluation.

The paper is organized as follows; After describing the assumptions of the model in the next section I distinguish in Sections 3 and 4 between the case that all consumers are active in the market and the case that a segment of the population refrains from consumption. Section 5 concludes the paper.

2. The Model

Consider two components of software that have to be used by consumers as a system, say the operating system and the web browser. While a single firm produces the operating system (Microsoft) two firms offer competing web browsers (Netscape and Microsoft.) Computer manufacturers have to install the only available operating system in conjunction with a web browser prior to selling their computers to customers. There are two such manufacturers in the market (say Dell and Compaq.)

Consumers consider the two web browsers as well as the computers produced by different manufacturers as differentiated products. To capture this differentiation, I assume that the "ideal points" of the population of consumers with respect to the web browsers are uniformly distributed on a line of one unit length with the two existing web browsers located at the endpoints of this line. Each consumer incurs transportation costs equal to t_2 per unit of distance when purchasing a web-browser located, in terms of its characteristics away from the consumer's "ideal point." Similarly, the preferences with respect to computers are also represented by a uniform distribution of "ideal points" on a line of one unit length with the two manufacturers located at the end points of this line. The transportation parameter describing this distribution is designated by t_1. Hence, t_2 and t_1 measure the extent of differentiation between web-browsers and the computers of different manufacturers, respectively. I assume that the distribution of preferences between web-browsers is determined independent of the distribution of preferences between the two manufacturers. I designate by x the distance of the consumer from the manufacturer located at the left end point of the distribution of preferences among manufacturers, and by y her distance from the web browser located at the left end point of the distribution among browsers. I assume that Microsoft's Internet Explorer is located at the left and Netscape Navigator at the right end points of this distribution. When a consumer uses the computer and the web-browser whose characteristics exactly match her "ideal point" she derives utility equal to v, which can be interpreted as her reservation price. This level of utility declines to $(v - t_1 x - t_2 y)$ when a consumer of type x, y buys the computer and web-browser located at the left end point of the corresponding distribution.

I assume that consumers prefer that the computer manufacturer installs the operating system and the web browser since they experience technical difficulties in installing those systems themselves. Moreover, they experience much greater difficulties in installing the operating system than in installing the web browser. Specifically, while they are unable to install the operating system no matter the resources spent, they can install a browser at an additional cost of k dollars (beyond the cost level incurred by the manufacturer.)

It is clear that since manufacturers incur lower costs of installation than consumers, efficiency dictates that software companies sell their systems through computer manufacturers rather than directly to consumers. However, since my objective in the paper is to assess the possibility that the monopolistic firm uses its monopoly position in one market to exclude its competitor from the complementary browsers market by bundling its products together, I allow for the possibility that Netscape chooses to sell its browser directly to consumers. I designate by p_N the price that Netscape charges from consumers in that case. Such a formulation guarantees that Netscape may have a viable "outside option" even when it cannot reach an agreement with the manufacturers.

Since consumers do not normally purchase the software directly from Microsoft and Netscape, manufacturers have to negotiate with software producers terms of trade for licensing their technologies. As a result of such negotiations, computer manufacturer i agrees to pay Microsoft r_T^i per installation when installing a complete system comprising of both Windows and Internet Explorer (T designates total system). Let r_w^i designate the price to be paid to Microsoft when installing only its operating system (w designates Windows only.) Similarly, let r_N^i designate the negotiated price between producer i and Netscape when the web browser of choice that is installed is Netscape's Navigator. I designate by p_s^i the price charged from consumers by manufacturer i when selling a new computer comprising of both the hardware and the software installed.

In the absence of any restrictions imposed by Microsoft, the manufacturer is free to combine Microsoft's operating system with Netscape's web browser, when requested by consumers. If Microsoft integrates Internet Explorer into its operating system manufacturers are

forced to install Explorer as the web browser regardless of the preferences of consumers. As pointed out earlier, Netscape can still try to sell its product directly to consumers in that case.

For simplicity, I assume that all producers (of software as well as hardware) incur only fixed cost of production.[1]

I model the game as consisting of two stages. At the first stage, manufacturers negotiate with Microsoft and Netscape and simultaneously set prices to be charged from consumers. I assume that if a given manufacturer fails to reach an agreement with a software producer the parties can never renegotiate in the future. In addition, each manufacturer cannot observe the outcome of the negotiations of its competitors. The assumption that in the first stage negotiations take place simultaneously with price setting can be replaced with a sequential move type of game, where negotiations precede price setting. As long as a given computer manufacturer cannot observe the terms of trade secured by its competitor the simultaneous and sequential move arrangements yield identical results. In the second stage of the game Netscape decides whether to sell its product directly to consumers and under what terms.[2]

To model the negotiations between computer manufacturers and software producers I use the Nash Bargaining Solution. Using this cooperative solution concept to model the bilateral negotiations between a given manufacturer and a given software producer does not prohibit me from capturing the possibility that fierce competition may exist between the two manufacturers or between the two web browsers as reflected, for instance, by the values of the parameters t_1 and t_2. Since the Nash Bargaining Solution is computed by identifying payoffs that accrue to the negotiating parties both in case of agreement as well as disagreement between them, the extent of competition in the different markets is built into such calculations. For instance, reduced differentiation between the two web browsers as reflected by a smaller value of t_2 implies that the "outside option" of a given manufacturer is more favorable in case of disagreement with Netscape.

[1] Such an assumption is equivalent to a constant per unit variable cost. All of the qualitative results remain unchanged with such a positive per unit variable cost, even when those variable costs vary across different firms.
[2] Even though I do not consider the possibility that Microsoft can also sell directly to consumers it is easy to demonstrate that this option is never profitable for Microsoft given its monopoly position in the operating systems market and the fact that consumers incur higher installation cost than manufacturers.

Its bargaining position vis-à-vis Netscape should be stronger, therefore, thus translating to a lower negotiated price for licensing Netscape's technology.

To solve for sub-game perfect equilibria I start by considering the second stage when Netscape decides whether to offer its browser directly to consumers. It is clear that such an option may be attractive if Netscape could not reach an agreement with at least one of the manufacturers.[3] In case of disagreement between Netscape and a given manufacturer i, Internet Explorer is installed on every computer sold by this manufacturer regardless of the preferences of the consumer. If Netscape sells its product to one of manufacturer i's customers as a second browser, this customer has to install the browser herself. Only if the customer has a strong preference for the Navigator will she consider buying the second browser which costs her an extra price of $(p_N + k)$ inclusive of the cost of installation. Specifically, let manufacturer i be the one located at the left end point of the distribution of preferences between manufacturers, then all consumers of type y satisfying the inequality.

$v - t_1 x - t_2 y - p_s^i \leq v - t_1 x - t_2(1-y) - p_s^i - (p_N + k)$ will have an incentive to install the Navigator as a second browser even though Internet Explorer has already been installed on their computers. The fraction of manufacturer i's consumers who install the second browser is equal, therefore, to:

$$D_N = \frac{1}{2} - \frac{p_N + k}{2t_2}$$

Maximizing its profits from direct sale yields the optimal pricing policy summarized in Lemma 1.

Lemma 1

(i) If $t_2 \geq k$ the optimal price charged by Netscape is: $p_N = (t_2 - k)/2$.
(ii) If $t_2 < k$ Netscape will not be able to sell its product directly to consumers in case of disagreement with a certain manufacturer.

According to the above Lemma only if the extent of differentiation between browsers is sufficiently high so that it exceeds the cost of installation of a second browser will there be a direct market for Netscape's product. The outcome of the negotiations between the manufacturers and

[3] Note that in case of disagreement between Microsoft and a given manufacturer i, the latter loses its entire customer base to its competitor since Microsoft is the only supplier of operating systems. There is no point, therefore, for

the software producers depends upon the feasibility of direct sales of software to consumers. The existence of such a market determines the outside options available to Netscape in its negotiations. In the analysis that follows I distinguish, therefore, between the case that $t_2 \geq k$ and $t_2 < k$.

In addition, the negotiations depend also upon the demand facing the computer manufacturers as a function of the prices they charge and the extent of restrictions they impose on the type of browser that their customers can select. To derive those demand functions I start by assuming that both producers do not restrict the choice of browser to be selected by their customers; thus installing the preferred browser as requested by each of them. Given the utility specification of the consumers, the demand facing manufacturer i is given[4], therefore, by:

(1)

$$D_i\left(p_s^i, p_s^j\right) = \frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1} \quad ,$$

if every individual purchases a computer and the entire market is served. If, however, the prices charged by the manufacturers are sufficiently high, it is possible that some consumers, whose "ideal points" are located sufficiently far away from the location of the manufacturers, decide to withdraw from the market completely and not buy a computer. The demand facing manufacturer i in that case is given by:

(2)

$$D_i\left(p_s^i, p_s^j\right) = \frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_s^i}{t_1} \quad .$$

Note that while the threshold consumer who determines the demand when the market is completely covered is indifferent between buying the computer from manufacturer i or j, the threshold consumer in case of less than full coverage of the population is indifferent between buying the computer of manufacturer i or forgoing consumption of computer services altogether. Hence,

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Microsoft to consider a direct sale of its web browser to the remaining customers of manufacturer i, given that the latter has lost all customers in case of disagreement with Microsoft.

[4] When the population is completely covered the threshold consumer x^* who is indifferent between buying from i or j satisfies the equalty $v - p_s^i - t_1 x^* - Min\{t_2 y, t_2(1-y)\} = v - p_s^j - t_1(1-x^*) - Min\{t_2 y, t_2(1-y)\}$. The demand facing i consists of all x values less than x^*. When the population is not completely covered the threshold consumer x^* who is indifferent between buying from i or withdrawing from the market is given by: $v - p_s^i - t_1 x^* - Min\{t_2 y, t_2(1-y)\} = 0$. The demand facing i consists of all $x \leq x^*$.

while in the former case the manufacturers compete against each other in attracting customers in the latter case each manufacturer has a local monopoly over a certain segment of the population. In addition, note that the underlying assumption in the derivation of the demand in (1) and (2) is that each computer manufacturer has to quote a single price for its computers irrespective of which browser is requested by customers. Most manufacturers post indeed a single price for their machines irrespective of the type of software they install on it.

If manufacturer j does not impose restrictions on customers while manufacturer i restricts the choice of its customers to a single browser (either because it couldn't reach an agreement with one of the software producers or because Microsoft bundled its browser as part of the operating system), the demand facing i will be lower than (1) or (2). Manufacturer i's customers can either use the single web browser of Microsoft that is installed by i or purchase a second browser at the price p_N directly from Netscape, if such a direct sale market exits. The consumer of type (x, y) derives the utility level $\left[v - t_1 x - Min\{t_2 y, (t_2(1-y) + p_N + k)\} - p_s^i\right]$ as a result. If the same consumer were to switch to manufacturer j her net utility would be $\left[v - t_1(1-x) - Min\{t_2 y, t_2(1-y)\} - p_s^j\right]$. Given the above net utility expressions I derive in Lemma 2 the demand facing manufacturer i if it is the only one to restrict the choice of customers. All proofs of Lemmas and Propositions are included in the Appendix.

Lemma 2

When manufacturer i restricts the choice of its customers to the single web browser offered by Microsoft then:

(i) If the market is completely covered and the competitor does not impose any restrictions, the demand facing i is:[5]

[5] I assume an interior equilibrium where both manufacturers are active in the market, implying that each faces a positive level of demand.

(3)

$$D_i\left(p_s^i, p_s^j\right) = \begin{cases} \frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1} - \frac{(t_2 + k)(3t_2 - k)}{32t_1t_2} & \text{if } t_2 \geq k \\ \frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1} - \frac{t_2}{8t_1} & \text{if } t_2 < k \end{cases}$$

(ii) If the market is not completely covered the demand facing i is :

(4)

$$D_i\left(p_s^i, p_s^j\right) = \begin{cases} \frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_s^i}{t_1} - \frac{(t_2 + k)(3t_2 - k)}{16t_1t_2} & \text{if } t_2 \geq k \\ \frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_s^i}{t_1} - \frac{t_2}{4t_1} & \text{if } t_2 < k \end{cases}$$

A comparison of (3) and (4) with (1) and (2) indicates that the reduction in the demand facing i as a result of the imposition of restrictions on consumers' choice is more severe when a direct sale market for Netscape's product does not exist (i.e. $t_2 < k$.)

If both producers restrict the choice of their customers to the single web browser offered by Microsoft the demand facing each remains as specified in (1) if the market is completely covered. With a local monopoly, however, each producer loses some customers due to the restrictions it imposes. The demand facing it is still as specified in (4).

3. Negotiations Between Computer Manufacturers and Software Companies when the Market is Completely Covered.

In order to investigate the effect of the negotiations on the equilibria I consider first, as a benchmark the case that both software producers sell their products directly to consumers. Consumers are assumed, therefore to be able to install the software products themselves without requiring the services of intermediaries. Let k_W be the cost of installing the operating system and k the cost of installing either one of the two web browsers by the consumers. When Microsoft

does not bundle its browser with its operating system it sets the price r_W for Windows and the price $r_E \equiv (r_T - r_W)$ for the Explorer. Netscape sets the price r_N for the navigator. In response, consumers buy the operating system and combine it with the browser that minimizes the sum of the transportation and direct cost of using the browser (i.e. $Min\{(r_E + k + t_2 y), (r_N + k + t_2(1-y))\}$.) Assuming that the entire market is covered, the demand facing each browser is given therefore, as:

$$D_j = \frac{1}{2} + \frac{r_i - r_j}{2t_2}, \text{ where } i, j = E, N \quad E \neq N.$$

The profits of Microsoft amount to $(r_W + D_E r_E)$ and those of Netscape are $D_N r_N$. The parties choose their prices (r_N and r_E for Microsoft and r_N for Netscape) to maximize their respective profits, yielding the solution that $r_E = r_N = t_2$ and $r_W = v - \frac{3}{2}t_2 - k_W - k$, where the latter price is chosen by Microsoft to extract the entire surplus of the consumer who is just indifferent between the two browsers.

When Microsoft bundles its two products together Netscape is either excluded from the market completely if $t_2 < k$, or it can still sell its browser as a second browser for the price $p_N = (t_2 - k)/2$. In the former case, Microsoft sets the price r_T of its combined system at $r_T = v - t_2 - k_W - k$. Such a price extracts the entire surplus of the consumer who is located in the distribution the farthest away from the Explorer. When Netscape can continue to sell its browser in spite of the bundling strategy of Microsoft (i.e. when $t_2 \geq k$,) the segment of the consumers who choose to install a second browser amounts to $(t_2 - k)/4t_2$. The highest price r_T that Microsoft can charge for its combined system, in this case extracts the entire surplus of the consumer who is just indifferent between installing the Navigator as a second browser or using the Explorer instead (i.e. $r_T = v - \frac{(3t_2 + k)}{4} - k_W - k$.) The above calculations imply the result reported in Lemma 3.

Lemma 3

Assuming that the entire market is covered and software producers sell their systems directly to consumers, Microsoft strictly prefers to bundle its products together when $t_2 > k$. Otherwise, when $t_2 \leq k$ Microsoft is just indifferent between bundling or selling its systems separately.

In the sequel I show that the existence of the negotiations between the software producers and the manufacturers who serve as intermediaries between the consumers and the software companies may reverse the above result. In particular, when Microsoft has a strong negotiating position vis-à-vis the manufacturers it strictly prefers not to bundle its products together.

I start by considering the negotiations when no restrictions on choice are imposed, and each consumer can request that the manufacturer installs the web browser she prefers the best. The agreement payoffs in the negotiations between Microsoft and manufacturer i over the payments r_T^i *and* r_W^i per unit are given as follows:

$$S_i = \left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1}\right)\left(p_s^i - \frac{1}{2}r_T^i - \frac{1}{2}r_W^i - \frac{1}{2}r_N^i\right) \tag{5}$$

$$M = \left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1}\right)\left(\frac{1}{2}r_T^i + \frac{1}{2}r_W^i\right) + \left(\frac{1}{2} + \frac{p_s^i - p_s^j}{2t_1}\right)\left(\frac{1}{2}r_T^j + \frac{1}{2}r_W^j\right) \; i, j = 1,2; i \neq j,$$

where S_i is the payoff of manufacturer i and M the payoff of Microsoft in case of agreement. Note that since no restrictions are imposed, half of the population of consumers who buy a certain computer request that the manufacturer installs Microsoft's Internet Explorer and the second half requests the Navigator. In the former case the manufacturer incurs the cost r_T^i according to the payment to Microsoft for a complete system and in the latter case this cost is equal $\left(r_W^i + r_N^i\right)$, which corresponds to the combined payments to Microsoft and Netscape.

In case of disagreement between i and Microsoft computer manufacturer i loses its entire customer base since Microsoft is the only supplier of operating systems in the market. The payoff to Microsoft depends upon whether the market remains completely covered after the disagreement as specified by the following disagreement payoffs:

$$S_i^* = 0$$

(6)

$$M^* = \begin{cases} \frac{1}{2} r_T^j + \frac{1}{2} r_W^j & \text{if the market remains completely covered} \\ \left(\frac{\mathrm{v}}{\mathrm{t}_1} - \frac{t_2}{4t_1} - \frac{p_s^j}{t_1} \right) \left(\frac{1}{2} r_T^j + \frac{1}{2} r_W^j \right) & \text{if the disagreement results in some consumers being unserved} \end{cases}$$

The disagreement payoffs correspond to the outside options available to the parties in case they fail to reach an agreement.

The Nash Bargaining Solution that determines the payments r_T^i *and* r_W^i to Microsoft maximizes the following expression:

(7)

$$\underset{r_T^i, r_W^i}{Max} \left(S_i - S_i^*\right)^{l_1} \left(M - M^*\right)^{(1-l_1)},$$

If the relationship between i and Microsoft generates a positive net surplus so that $\left[(S_i + M) - (S_i^* + M^*)\right] > 0$, the weights l_1 and $(1 - l_1)$ determine the shares of this combined surplus that accrue to the manufacturer and to Microsoft, respectively. Hence the bigger the value of l_1 the larger the share of this surplus that accrues to the manufacturer. When $l_1 = 0.5$ the two parties agree to share equally the surplus generated in the negotiations, implying that each receives $0.5\left(S_i + M - S_i^* - M^*\right)$ in excess of its outside option. If the relationship does not generate any positive net surplus the parties dissolve their relationship completely and the payoff to each is determined by its outside option.

Optimizing (7) with respect to r_T^i *and* r_W^i, provided that the market remains completely covered following a disagreement, yields the following first order condition:

(8)

$$(1-l_1)\left(p_s^i-\frac{1}{2}r_T^i-\frac{1}{2}r_w^i-\frac{1}{2}r_N^i\right)-l_1\left(\frac{1}{2}r_T^i+\frac{1}{2}r_W^i-\frac{1}{2}r_T^j-\frac{1}{2}r_W^j\right)=0.$$

Note that at the symmetric equilibrium where both manufacturers charge identical prices $\left(p_S^i=p_S^j\right)$ and pay identical rates to license the technology $\left(r_T^i=r_T^j, r_W^i=r_W^j, r_N^i=r_N^j\right)$ Microsoft ends up extracting the entire surplus of each producer so that

(9)

$$\frac{1}{2}r_T^i+\frac{1}{2}r_W^i=p_s^i-\frac{1}{2}r_N^i.$$

Hence when manufacturers compete against each other in attracting customers and the market remains completely covered, irrespective of whether Microsoft reaches an agreement with one of the manufacturers, Microsoft can utilize its monopoly position in operating systems to eliminate the entire profits of each manufacturer irrespective of the value of l_1. In contrast, if a disagreement with one of the manufacturers results in some consumers leaving the market, the optimization of (7) yields:

(10)

$$\left(\frac{1}{2}+\frac{p_S^j-p_S^i}{2t_1}\right)\left[(1-l_1)\left(p_S^i-\frac{1}{2}r_T^i-\frac{1}{2}r_W^i-\frac{1}{2}r_N^i\right)-l_1\left(\frac{1}{2}r_T^i+\frac{1}{2}r_W^i-\frac{1}{2}r_T^j-\frac{1}{2}r_W^j\right)\right]$$
$$-l_1\left[1-\left(\frac{v}{t_1}-\frac{t_2}{4t_1}-\frac{p_S^j}{t_1}\right)\right]\left[\frac{1}{2}r_T^j+\frac{1}{2}r_W^j\right]=0$$

At the symmetric equilibrium, therefore,

(11)

$$\frac{1}{2}r_W^i+\frac{1}{2}r_T^i=\frac{\left(p_S^i-\frac{1}{2}r_N^i\right)}{\left[1+\frac{2l_1}{1-l_1}\left(1-\left(\frac{v}{t_1}-\frac{t_2}{4t_1}-\frac{p_S^i}{t_1}\right)\right)\right]}<\left(p_S^i-\frac{1}{2}r_N^i\right)$$

implying that Microsoft can no longer extract the entire surplus of each manufacturer. Since a disagreement with a manufacturer inflicts some damage on Microsoft in this case in the form of a smaller base of customers--the negotiating position of the manufacturers is improved.

In Observation 1 I demonstrate that the pricing behavior of the manufacturers will be such that it can never support an equilibrium where the market will remain completely covered following a disagreement between Microsoft and one of the manufacturers.

Observation 1

There is no symmetric equilibrium that is consistent with the market being fully covered both in the case of agreement and in case of disagreement with one of the manufacturers.

Since each computer manufacturer has the freedom to choose the price it charges from consumers it always has an incentive to raise this price sufficiently so that some damage is inflicted on Microsoft in case it fails to reach an agreement with the manufacturer. When the prices charged by the manufacturers are sufficiently high, failing to reach an agreement with one of them implies that some consumers drop out of the market altogether, thus reducing the number of systems that Microsoft is able to sell. Note that Microsoft's inability to extract the entire surplus of each manufacturer in this case does not depend upon the assumption that only linear transfer prices (r_T and r_W) are considered in the negotiations. Even with non-linear (transfer) price schedules the manufacturers can still select the prices they charge from the consumers to guarantee that Microsoft loses if it is unable to reach an agreement with one of them. As long as there is some product differentiation between the manufacturers, each is not completely powerless in the negotiations with Microsoft.

Each manufacturer chooses its price to maximize its agreement payoff S_i, yielding the first order condition:

(12)

$$\frac{1}{2}+\frac{p_S^j-2p_S^i}{2t_1}+\frac{\frac{1}{2}r_T^i+\frac{1}{2}r_W^i+\frac{1}{2}r_N^i}{2t_1}=0$$

Combining this condition with (10) yields the following solution for the price of a new computer, p_S, in terms of the negotiated rate agreed with Netscape, r_N, at the symmetric equilibrium.

(13)

$$p_S = \frac{\left(v - \frac{t_2}{4} + \frac{r_N}{2}\right) + \sqrt{\left(v - \frac{t_2}{4} - \frac{r_N}{2}\right)^2 - 4t_1\left(v - \frac{t_2}{4} - \frac{(1+l_1)}{2l_1}t_1 - \frac{1}{2}r_N\right)}}{2}$$

It is easy to demonstrate that the above solution yields indeed less than full coverage of the population in case of disagreement since $p_S > v - t_1 - \frac{t_2}{4}$, implying that a manufacturer located at one end of the market cannot offer a positive surplus to the consumer located at the other end of the market given the equilibrium price of new computers.

Next I consider the negotiations between Netscape and the manufacturers. In negotiating with manufacturer i the following are the agreement payoffs that accrue to the parties:

$$S_i = \left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1}\right)\left(p_s^i - \frac{1}{2}r_T^i - \frac{1}{2}r_W^i - \frac{1}{2}r_N^i\right)$$

(14)

$$N = \left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1}\right)\left(\frac{1}{2}r_N^i\right) + \left(\frac{1}{2} + \frac{p_s^i - p_s^j}{2t_1}\right)\left(\frac{1}{2}r_N^j\right)$$

In case of disagreement between Netscape and manufacturer i the latter installs Internet Explorer on each of its computers irrespective of the preferences of its customers.[6] Since the competing manufacturer tailors the installation to the customer's tastes the demand facing i declines according to the specification in (3). Netscape continues to serve the competitor's clients as well as sells its software directly to some of $i's$ customers if such a direct sale market exists $(t_2 \geq k)$. The disagreement payoffs are equal, therefore, to:

when $(t_2 \geq k)$

[6] A disagreement with Netscape does not result in less than full coverage of the population since both manufacturers continue to serve the market.

$$S_i^* = \left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1} - \frac{(t_2+k)(3t_2-k)}{32t_1t_2}\right)\left(p_s^i - r_T^i\right)$$

(15.a)

$$N^* = \left(\frac{1}{2} + \frac{p_s^i - p_s^j}{2t_1}\right)\frac{r_N^j}{2} + \frac{(t_2+k)(3t_2-k)r_N^j}{32t_1t_2} + \frac{(t_2-k)^2}{8t_2}\left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1} - \frac{t_2+k}{4t_1}\right)$$

when $(t_2 < k)$

$$S_i^* = \left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1} - \frac{t_2}{8t_1}\right)\left(p_s^i - r_T^i\right)$$

(15.b)

$$N^* = \left(\frac{1}{2} + \frac{p_s^i - p_s^j}{2t_1}\right)\frac{r_N^j}{2} + \frac{t_2}{8t_1}\, r_N^j$$

At the Nash Bargaining Solution, the payment r_N^i that is negotiated between manufacturer i and Netscape solves the following maximization problem:

(16)

$$\underset{r_N^i}{Max}\left(S_i - S_i^*\right)^{l_2}\left(N - N^*\right)^{1-l_2},$$

provided that the net surplus generated in the transaction between them is positive, namely if $\left[\left(S_i - S_i^*\right) + \left(N - N^*\right)\right]$ is positive. If the latter is negative the parties fail to reach an agreement. The parameter l_2 in (16) corresponds to the share of the net surplus (if positive) that accrues to the manufacturer in the negotiations with Netscape. Hence a bigger value of l_2 corresponds to an improved bargaining position of the manufacturer. Optimizing with respect to r_N^i yields:

when $(t_2 \geq k)$

$$\left(\frac{1}{2} + \frac{p_s^j - p_s^i}{2t_1}\right)\left[(1-l_2)\frac{\left(r_T^i - r_W^i\right)}{2} - \frac{r_N^i}{2}\right] + \frac{(t_2+k)(3t_2-k)}{32t_1t_2}\left[(1-l_2)\left(p_s^i - r_T^i\right) + l_2\, r_N^j\right]$$

(17)

$$+\ l_2\frac{(t_2-k)^2}{8t_2}\left(\frac{1}{2}+\frac{p_s^j-p_s^i}{2t_1}-\frac{(t_2+k)}{4t_1}\right)=0$$

if

$$(S_i-S_i^*)+(N-N^*)=\left(\frac{1}{2}+\frac{p_s^j-p_s^i}{2t_1}\right)\left(\frac{r_T^i-r_W^i}{2}\right)+\frac{(t_2+k)(3t_2-k)(p_s^i-r_T^i-r_N^j)}{32t_2t_1}$$
$$-\frac{(t_2-k)^2}{8t_2}\left(\frac{1}{2}+\frac{p_s^j-p_s^i}{2t_1}-\frac{t_2+k}{4t_1}\right)>0$$

and when $t_2<k$

(18)

$$\left(\frac{1}{2}+\frac{p_s^j-p_s^i}{2t_1}\right)\left[(1-l_2)\left(\frac{r_T^i-r_W^i}{2}\right)-\frac{r_N^i}{2}\right]+l_2\frac{t_2}{8t_1}r_N^j+(1-l_2)\frac{t_2}{8t_1}(p_s^i-r_T^i)=0$$

if

$$(S_i-S_i^*)+(N-N^*)=\left(\frac{1}{2}+\frac{p_s^j-p_s^i}{2t_1}\right)\frac{(r_T^i-r_W^i)}{2}+\frac{t_2}{8t_1}(p_s^i-r_T^i-r_N^j)>0$$

Note from (17) and (18) that the negotiated payment r_N^i is lower the smaller is the gap $(r_T^i-r_W^i)$, namely the smaller the price differential paid to Microsoft between a complete system and an operating system only. In particular, when Microsoft integrates the browser as part of the operating system so that $r_T^i=r_W^i$ circumstances may arise under which the manufacturers actually refuse to negotiate with Netscape (when $(S_i-S^*+N-N^*)<0$). We characterize those circumstances in Observation 2.

Observation 2

If Microsoft integrates the browser as part of the operating system so that $r_T^i=r_W^i$ Netscape may not be able to reach an agreement with either one of the manufacturers when t_1 is sufficiently small. Specifically, Netscape is foreclosed from the negotiations.

(i) When $t_2 \geq k$

if $t_1 \leq t_1^*$ where $t_1^* \in \left(\frac{(t_2+k)(3t_2-k)}{16t_2}, \frac{(t_2+k)(3t_2-k)}{8t_2} \right)$

(ii) and when $t_2 < k$, if $t_1 < \frac{t_2}{2}$.

In all other circumstances, Microsoft cannot prevent the negotiations between the manufacturers and Netscape even when it integrates the browser as part of the operating system.

The degree of differentiation between computer manufacturers determines their negotiating position vis-a-vis Microsoft and Netscape. Higher degrees of differentiation permit each manufacturer to capture a larger share of the surplus generated in the negotiations. This surplus is larger, in turn, the higher the willingness to pay of customers. Enhanced freedom of choice between browsers increases this willingness to pay. As a result, when manufacturers can expect to extract a larger share of the surplus generated downstream (when t_1 is relatively large) they have good reason to offer freedom of choice to their customers even when Microsoft integrates Explorer as a part of Windows. Observation 2 states that the situation is different, however, when manufacturers obtain only a very small share of the surplus in the negotiations (when t_1 is small). In that case, when $r_T^i = r_W^i$, manufacturers may refuse to negotiate with Netscape altogether.

Despite of the fact that Microsoft may be able to prevent the negotiations between computer manufacturers and Netscape (for small t_1 values), it is not necessarily clear that it will find it advantageous to do so. In fact, in the sequel I demonstrate that Microsoft may earn higher profits if it selects the gap $\Delta \equiv r_T^i - r_W^i$ in such a manner that supports negotiations with Netscape. However, higher values of Δ yield larger values of the negotiated rate r_N with Netscape, which reduces the profits of Microsoft according to (11). Hence, in order to maximize its own profits while supporting the negotiations between manufacturers and Netscape, Microsoft should choose the difference Δ to be at the smallest possible level that still supports such negotiations. This lower bound on Δ is determined by the requirement that $(S_i - S_i^*) + (N - N^*) = 0$. Using the above observation I characterize in Proposition 1 Microsoft's profit maximizing *non-exclusionary*

equilibrium (that supports negotiations between computer manufacturers and Netscape) when it actually has the ability to exclude Netscape (by bundling its product together).

Proposition 1

When t_1 is sufficiently small so that Microsoft can prevent negotiations with Netscape by choosing $\Delta = 0$, the existence of a non-exclusionary equilibrium requires that $\Delta > 0$ so that $(S_i - S_i^*) + (N - N^*) \geq 0$. The non-exclusionary equilibrium that generates the highest profits to Microsoft has the following characteristics:

$$r_N = \begin{cases} \dfrac{(t_2 - k)^2}{4t_2} \dfrac{\left(\dfrac{1}{2} - \dfrac{t_2 + k}{4t_1}\right)}{\left(\dfrac{1}{2} - \dfrac{(t_2 + k)(3t_2 - k)}{16t_1 t_2}\right)} & \textit{if } t_2 \geq k \\ 0 & \textit{if } t_2 < k \end{cases}$$

$$M = \frac{r_T + r_W}{2} = \frac{\left(v - \dfrac{t_2}{4} - 2t_1 - \dfrac{r_N}{2}\right) + \sqrt{\left(v - \dfrac{t_2}{4} - 2t_1 - \dfrac{r_N}{2}\right)^2 + \dfrac{(1-\lambda_1)}{2\lambda_1} 4t_1^2}}{2}$$

Note that the negotiated rate r_N between Netscape and each manufacturer is lower than the price Netscape charges from consumers who choose to install a second browser by buying it directly from Netscape. Since the direct sale price p_N is paid only by very loyal consumers who have a strong preference for the Navigator $\left(i.e.\ y > \dfrac{1}{2} + \dfrac{t_2 + k}{4t_2}\right)$, while the negotiated price r_N is paid by the manufacturer on behalf of a larger group of consumers $(y > 0.5)$ who request this browser, Netscape agrees to accept a lower payment per unit in return for the larger volume of sales. Note also that if a direct sale market does not exist Netscape is forced to accept a payment of zero for its browser.

Proposition 2 characterizes the equilibrium when the price differential $(r_T - r_W)$ is chosen to be sufficiently small so that negotiations between the manufacturers and Netscape are not feasible. This characterization applies, in particular to the case that $r_T = r_W$ which corresponds to the integration of Internet Explorer as part of the Windows operating system.

Proposition 2

When t_1 is sufficiently small and the price differential $\Delta = (r_T - r_W)$ is so small that manufacturers break off negotiations with Netscape, the price of a new computer to consumers is given by:

$$p_S = \frac{v - \frac{t_2}{2} + \sqrt{\left(v - \frac{t_2}{2} - 2t_1\right)^2 + 4t_1^2 \frac{(1-l_1)}{2\,l_1}}}{2}$$

and the profits of Microsoft are:

$$M = p_S - t_1 = \frac{v - \frac{t_2}{2} - 2t_1 + \sqrt{\left(v - \frac{t_2}{2} - 2t_1\right)^2 + 4t_1^2 \frac{(1-l_1)}{2\,l_1}}}{2}.$$

A comparison of the payoffs to Microsoft from Propositions 1 and 2 yields the conclusion summarized in Proposition 3.

Proposition 3

When the market is completely covered and the degree of differentiation between manufacturers is so small that Microsoft can prevent negotiations with Netscape, Microsoft prefers not to block such negotiations. It earns higher profits if manufacturers are able to reach an agreement with Netscape, thus allowing them to install the preferred browser as requested by each consumer.

When the market is fully covered and the degree of differentiation between manufacturers is small each computer manufacturer has a weak bargaining position vis-a-vis Microsoft. As a

result, Microsoft can utilize its monopoly position in the operating systems market in order to extract a very large portion of the consumer surplus. This surplus is higher, in turn, when the consumer is free to choose between browsers according to her preferences without having to incur the additional cost of installing the browser herself (when having to buy directly from Netscape). The above discussion implies that, if Microsoft decides to integrate Explorer as part of its operating system when it has a very strong bargaining position vis-a-vis computer manufacturers, the motivation for such a decision cannot be the exclusion of Netscape from the market. Microsoft's claim, that it is the convenience of consumers it has in mind, sounds more convincing in this case in view of Proposition 3.

According to Observation 2, Microsoft cannot eliminate the profitability of the negotiations with Netscape when the degree of differentiation between manufacturers is relatively high. If Microsoft wishes to exclude Netscape from the market, integrating its browser into the operating system is insufficient in this case. It may have to consider additional measures such as including exclusivity clauses in its contracts with manufacturers or installing a bug in the operating system that leads to incompatibility with Netscape's product. In the sequel, I demonstrate that such exclusionary practices are not necessarily profitable to Microsoft.

Proposition 4

When the market is completely covered and the degree of differentiation between manufacturers is relatively high, Microsoft finds it optimal to integrate the browser into the operating system so that $r_T = r_W$. If no explicit exclusionary practices are utilized, manufacturers find it optimal to negotiate with Netscape, yielding the following approved rate in the negotiations.

$$r_N = \begin{cases} \dfrac{\dfrac{(t_2+k)(3t_2-k)(1-l_2)}{8t_2} + \dfrac{l_2(t_2-k)^2}{2t_2}\left(\dfrac{1}{2} - \dfrac{t_2+k}{4t_1}\right)}{\left[1 - \dfrac{(1+l_2)(t_2+k)(3t_2-k)}{16t_1t_2}\right]} & \text{when } t_2 \geq k \\ \dfrac{2t_1t_2(1-l_2)}{[4t_1 - t_2(1+l_2)]} & \text{when } t_2 < k \end{cases}$$

The imposition of explicit restrictions on the manufacturers is unprofitable to Microsoft provided that $r_N < \frac{t_2}{2}$. The above inequality is more likely to hold the weaker the negotiating position of Netscape, namely, when t_2 is relatively small and l_2 is relatively large.

According to Proposition 4, it is impossible in general to determine whether Microsoft will have incentives to include explicit restrictions in the contracts with manufacturers. However, if Netscape has a weak bargaining position, such restrictions are definitely unprofitable. For instance, when $t_2 < k$ exclusivity clauses are unprofitable provided that $\frac{t_2(1+ l_2)}{4 l_2} < t_1$.

Proposition 4 is based upon the implicit assumption that the negotiated rate secured by Netscape permits it to cover its fixed costs of production (i.e. $0.5 \cdot r_N >$ fixed cost.) If the negotiated rate r_N is very small, however, Netscape may be forced out of the market when $r_T = r_W$. Microsoft has to compare in this case its profits when Netscape is excluded with its profits, when the gap between r_T and r_W is sufficiently high so that Netscape can survive (i.e., $\Delta \equiv (r_T - r_W)$ has to be chosen so that $0.5 \cdot r_N =$ fixed cost.) The exclusion of Netscape need not be profitable in this case as well. As pointed out earlier, in the negotiations with the computer manufacturers Microsoft can extract some of the efficiency gains generated when multiple brands are offered in the browsers market. It is not clear, therefore that the exclusion of Netscape is advantageous, even when Microsoft has to give up a significant portion of this added gains to the computer manufacturers, which is the case in proposition 4.

4. Negotiations Between Computer Manufacturers and Software Companies when the Market is less than Fully Covered

The agreement payoffs in the negotiations between Microsoft and computer manufacturer i are given from (2) as follows:

$$S_i = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_s^i}{t_1} \right) \left(p_s^i - \frac{1}{2} r_T^i - \frac{1}{2} r_W^i - \frac{1}{2} r_N^i \right) \qquad (19)$$

$$M = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_s^i}{t_1} \right) \left(\frac{1}{2} r_T^i + \frac{1}{2} r_W^i \right) + \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_s^j}{t_1} \right) \left(\frac{1}{2} r_T^j + \frac{1}{2} r_W^j \right)$$

In case of disagreement the outside option of the parties are obtained from (4) as follows:

$$S_i^* = 0$$

(20)

$$M^* = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_s^j}{t_1} \right) \left(\frac{1}{2} r_T^j + \frac{1}{2} r_W^j \right)$$

Computer manufacturer i loses its entire market due to the monopoly position of Microsoft in operating systems and Microsoft continues to trade with manufacturer j only.

Obtaining the Nash Bargaining Solution (the solution to (7)) yields:

(21)

$$\frac{r_T^i + r_W^i}{2} = (1 - l_1) \left(p_S^i - \frac{1}{2} r_N^i \right)$$

Similar to the result obtained in the previous section, failure to reach an agreement with one of the manufacturers inflicts damage on Microsoft in the form a smaller customer base. Microsoft is unable, therefore, to extract the complete surplus generated in the negotiations with manufacturers. In fact, when the market is less than fully covered, each manufacturer has a local monopoly in the market, thus strengthening its negotiating position even beyond that obtained with full coverage of the population.

The manufacturers choose the prices of new computers in order to maximize their agreement payoffs. Optimizing S_i with respect to p_S^i and using the solution in (21) yields the results reported in the following Lemma.

Lemma 3

At the symmetric equilibrium where $p_S^i = p_S^j$ and $r_k^i = r_k^j$; $k = T, W, N$, the following expressions correspond to the negotiated prices with Microsoft, the prices paid by consumers and the profits of Microsoft as a function of the negotiated rate r_N with Netscape.[7]

$$\frac{r_T + r_W}{2} = \frac{2(1-\lambda_1)}{(1+\lambda_1)}\left(\frac{v}{2} - \frac{t_2}{8} - \frac{r_N}{4}\right)$$

$$p_S^i = \left(\frac{v}{2} - \frac{t_2}{8}\right)\frac{2}{1+\lambda_1} + \frac{r_N\ \lambda_1}{2(1+\lambda_1)}$$

$$M = \frac{2\lambda_1(1-\lambda_1)}{t_1(1+\lambda_1)^2}\left(v - \frac{t_2}{4} - \frac{r_N}{2}\right)^2$$

Note that similar to the derivations in the previous section, Microsoft's profits increase the lower is the rate r_N negotiated between each manufacturer and Netscape. To derive this negotiated rate I specify the agreement and disagreement payoffs in the negotiations between manufacturer *i* and Netscape as follows:

$$S_i = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1}\right)\left(p_S^i - \frac{1}{2}r_T^i - \frac{1}{2}r_W^i - \frac{1}{2}r_N^i\right)$$

$$N = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1}\right)\frac{1}{2}r_N^i + \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^j}{t_1}\right)\frac{1}{2}r_N^j$$

$$S_i^* = \begin{cases} \left[\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1} - \frac{(t_2+k)(3t_2-k)}{16t_1t_2}\right]\left(p_S^i - r_T^i\right) & t_2 \geq k \\ \left[\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1} - \frac{t_2}{4t_1}\right]\left(p_S^i - r_T^i\right) & t_2 < k \end{cases}$$

[7] To guarantee that the market is less than fully covered the physical sales of each manufacturer should be smaller than 2. Imposing this restriction at the symmetric equilibrium yields $\left[\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{r_N}{2t_1}\right]\frac{l_1}{1+\lambda_1} < 0.5$.

$$N^* = \begin{cases} \dfrac{(t_2-k)^2}{8t_2}\left(\dfrac{v}{t_1}-\dfrac{t_2}{4t_1}-\dfrac{p_S^i}{t_1}-\dfrac{3(t_2+k)}{8t_1}\right)+\left[\dfrac{v}{t_1}-\dfrac{t_2}{4t_1}-\dfrac{p_S^j}{t_1}\right]\dfrac{1}{2}r_N^j & t_2 \geq k \\ \left[\dfrac{v}{t_1}-\dfrac{t_2}{4t_1}-\dfrac{p_S^j}{t_1}\right]\dfrac{1}{2}r_N^j & t_2 < k. \end{cases}$$

In case of disagreement with i, Netscape continues to serve j's customers and to sell directly to some of i's customers as well, if a direct sale market exists $(t_2 \geq k.)$ The first term of N^* corresponds to Netscape's proceeds from such direct sales. Solving for the Nash Bargaining Solution that satisfies (16) yields the results reported in Proposition 5.

Proposition 5

When the market is less than fully covered Microsoft cannot prevent the negotiations between the manufacturers and Netscape irrespective of the difference $(r_T - r_W)$ it selects. Even when Internet Explorer is integrated into its operating system so that $r_T = r_W$, each manufacturer finds it advantageous to negotiate with Netscape since the net surplus generated in the negotiations is strictly positive $(i.e\ \ [(S_i - S_i^*)+(N-N^*)]>0.)$

The result reported in Proposition 5 is similar to the one obtained in the previous section when the degree of differentiation between the manufacturers is relatively high. In both cases, manufacturers have a relatively strong bargaining position in the negotiations with Microsoft, implying that they continue to trade with Netscape even when Microsoft integrates its browser as part of the operating system. As in the previous section, and here as well, Microsoft can prevent the negotiations with Netscape only by including explicit exclusivity clauses in its contracts with the manufacturers. The inclusion of such clauses is not necessarily profitable, however, as is reported in Proposition 6.

Proposition 6

When the market is less than fully covered, Microsoft finds it optimal to integrate its browser as part of Windows. It is unprofitable for it to include exclusivity clauses in the contracts with

manufacturers provided that the negotiated price r_N with Netscape is relatively small. Specifically, when

$$\frac{r_N}{2} < R(t_2, k)$$

where

$$R(t_2,k) \equiv \begin{cases} \dfrac{(t_2+k)(3t_2-k)}{16t_2} & \text{if } t_2 \geq k \\ \dfrac{t_2}{4} & \text{if } t_2 < k \end{cases}$$

Once again, to guarantee non-exclusion, the bargaining position of Netscape should be sufficiently weak. Smaller values of t_2 and large values of l_2 are necessary to support the inequality included in Proposition 6.[8]

If the negotiated rate r_N of Proposition 6 is so small that Netscape is unable to cover its fixed costs, Microsoft compares, once again exclusion with the possibility of generating a positive gap between r_T and r_W to guarantee that Netscape can survive. Again, Microsoft's profits need not be higher with exclusion.

5. Concluding Remarks

I have developed a model to evaluate the leverage theory of product bundling in the context of negotiations between a monopolist and intermediaries who sell its products to consumers. I investigated whether the monopolist finds it feasible and advantageous to utilize product bundling in order to block negotiations between the intermediaries and a rival firm who competes against the monopolist in a complementary market. My results support the Chicago School conventional wisdom that product bundling is ineffective in extending monopoly power, even in this modified

[8] When $t_2 < k$ nonexclusion is profitable, for instance, if $t_2 < \dfrac{4\, l_2 v}{\left[\dfrac{1-\, l_2}{l_1} + 1 + \, l_2\right]}$.

environment where it affects the bargaining position of the monopolist in negotiations with powerful business partners. Specifically, the monopolist finds foreclosure of competitors via bundling either unprofitable or not feasible.

Even though I have utilized a very simple approach where differentiation among products is captured by a locational linear model and where the outcome of the negotiations is predicted by using the Nash Bargaining Solution, I believe that the results can be extended to a more general specification. The basic intuition that allowing consumers freedom of choice in consumption can benefit either the monopolist or the intermediaries with whom it bargains is likely to carry over to any model where consumers have heterogeneous preferences among products.

For illustrative purposes I formulated the model in the context of the operating systems and browsers markets. The results of my analysis apply, however more generally to any industry where influencing negotiations with business partners may be the motivating force for bundling. While utilizing the computer industry example is useful for expositional purposes my intention in the present paper has not been to render a definite judgement on the Department of Justice's case against Microsoft. The static nature of my model is simply insufficient to capture the dynamics involved in this case as stemming from the existence of network externalities or the potential threat to Microsoft's position in the operating systems market.

References

Adams, W. J. and Yellen, J. L., "Commodity Bundling and the Burden of Monopoly," *Quarterly Journal of Economics*, 1976, 90, 475-98.

Aghion, Phillppe and Bolton, Patrick, "Contracts as a Barrier to Entry," *American Economic Review*, 1987, 77, 388-401.

Bank, David, "Painful Struggle: How Microsoft Ranks Waged a Civil War on Windows' Future," *The Wall Street Journal Europe*, 02/01/1999.

Bork, Robert H., *The Antitrust Paradox*, New York: Basic Books, 1978.

Bowman, W. S., "Tying Arrangements and the Leverage Problem," *Yale Law Review*, November 1957, 67, 19-36.

Bridis, Ted, "Microsoft Claims Java Riddled with Flaws," *Portland Oregonian*, 12/04/98.

Chen, Yongmin, "Equilibrium Product Bundling," *Journal of Business*, 1997, 70, 85-103.

Chen, Yongmin, "Strategic Bidding by Potential Competitors: Will Monopoly Persist?" Working Paper, University of Colorado at Boulder, 1998.

Director, Aaron and Levi, Edward, "Law and the Future: Trade Regulation," *Northwestern University Law Review*, 1956, 51, 281-96.

Hart, Oliver and Tirole, Jean, "Vertical Integration and Market Forecbsure," *Brookings Papers on Economic Activity: Microeconomics*, 1990, 205-276.

McAfee, R. Preston, McMillan, John and Whinston, Michael D., "Multiproduct Monopoly, Commodity Bundling, and Correlation of Values, *Quarterly Journal of Economics*, May 1989, 104, 371-84.

Posner, Richard A., *Antitrust Law: An Economic Perspective*, Chicago: University of Chicago Press, 1976.

Rasmusen, Eric, Ramseyer, Mark, and Wiley, John, "Naked Exclusion," *American Economic Review*, 1991, 81, 1137-1145.

Salinger, Michael A., "A Graphical Analysis of Bundling," *Journal of Business*, 1995, 68, 85-99.

Schmalensee, Richard, "Commodity Bundling by Single-Product Monopolies," *Journal of Law and Economics*, April 1982, 25, 67-71.

Whinston, Michael D., "Tying, Foreclosure, and Exclusion," *American Economic Review*, September 1990, 80, 837-859.

Wilke, John R. and Perine, Keith, "Microsoft Says Java Disappointed Users Due to Its Own Shortcomings, Missteps," *The Wall Street Journal*, 12/04/98.

Appendix

Proof of Lemma 2

(i) If the market is completely covered and there exists a direct sale market for Netscape's product the consumers that choose manufacturer i satisfy the following inequalities:

$$x \le \frac{1}{2} + \frac{p_S^j - p_S^i}{2t_1} \qquad when \qquad 0 \le y \le \frac{1}{2}$$

$$x \le \frac{1}{2} + \frac{p_S^j - p_S^i}{2t_1} + \frac{t_2(1-y) - t_2 y}{2t_1} \qquad when \qquad \frac{1}{2} < y \le \frac{1}{2} + \frac{p_N + k}{2t_2} \quad \textbf{(A.1)}$$

$$x \le \frac{1}{2} + \frac{p_S^j - p_S^i}{2t_1} - \frac{(p_N + k)}{2t_1} \qquad when \qquad \frac{1}{2} + \frac{p_N + k}{2t_2} < y < 1.$$

Note that while the consumers in the third region above buy and install a second browser, consumers in the second region use Internet Explorer even though they would have preferred to use the Navigator.

Integrating over the above three regions and using the expressions derived for p_N In Lemma 1 yields the demand specified in (3). The derivation of the case when direct sales of the Navigator are not feasible is very similar. The only difference is that the third region of (A.1) does not exist in this case.

(ii) If manufacturer i has a local monopoly over a segment of the population whose "ideal points" are located close to it, its customers satisfy the following inequalities provided that there is a direct sale market for Netscape's browser.

$$x \le \frac{v - p_s^i - t_2 y}{t_1} \qquad if \quad 0 \le y \le \frac{1}{2} + \frac{p_N + k}{2t_2}$$

(A.2)

$$x \le \frac{v - p_S^i - t_2(1-y) - (p_N + k)}{t_1} \quad if \quad \frac{1}{2} + \frac{p_N + k}{2t_2} < y \le 1.$$

Proof of Observation 1

Each manufacturer chooses the price of its computer to maximize its agreement payoff yielding for *i*:

$$\frac{\partial S_i}{\partial p_S^i} = \frac{1}{2} + \frac{p_S^j - 2p_S^i}{2t_1} + \frac{\frac{1}{2}r_T^i + \frac{1}{2}r_W^i + \frac{1}{2}r_N^i}{2t_1}.$$

If a symmetric equilibrium with full coverage post-disagreement existed, the above expression would always be positive given the surplus extraction condition stated in (9). Hence, each producer would have an incentive to raise its price to the highest possible level that is consistent with full coverage of the market. This price would be set so that the surplus of the threshold consumer of type $x = 0.5$ is completely extracted, namely, $p_S = v - 0.5t_1 - 0.25t_2$. However, if manufacturer *i* raises the price even further to $p_S^i = v - 0.5t_1 - 0.25t_2 + e$ with $e > 0$, the market will be less than fully covered and the manufacturer's share will decline to $(0.5 - e/t_1)$. For fixed reimbursement rates agreed with Microsoft and Netscape according to (9) (i.e., $\frac{1}{2}r_T^i + \frac{1}{2}r_W^i + \frac{1}{2}r_N^i = v - 0.5t_1 - 0.25t_2$) such a deviation will benefit *i* since it raises its profits from zero to $(0.5 - e/t_1)e$. Hence, a contradiction to the assumption of full coverage. Q.E.D.

Derivation of Disagreement Payoffs of Netscape: Equations (15.a) and (15.b)

When $t_2 \geq k$ Netscape serves the customer of *j* whose *y* type is bigger than 0.5. The mass of those customers is obtained from (A.1) by the following integration:

$$\int_{\frac{1}{2}}^{\frac{1}{2}+\frac{p_N+k}{2t_2}} \int_{\frac{1}{2}+\frac{p_S^j-p_S^i}{2t_1}+\frac{t_2(1-y)-t_2 y}{2t_1}}^{1} dx\, dy + \int_{\frac{1}{2}+\frac{p_N+k}{2t_2}}^{1} \int_{\frac{1}{2}+\frac{p_S^j-p_S^i}{2t_1}-\frac{p_N+k}{2t_1}}^{1} dx\, dy$$

In addition customers of *i* of *y* type in the region $\left[\frac{1}{2} + \frac{p_N + k}{2t_2}, 1\right]$ install a second browser by buying directly from Netscape. Their mass is obtained from (A.1) as follow:

$$\int_{\frac{1}{2}+\frac{p_N+k}{2t_2}}^{1} \int_{0}^{\frac{1}{2}+\frac{p_S^j-p_S^i}{2t_1}-\frac{p_N+k}{2t_1}} dx\, dy$$

Substituting for p_N from Lemma 1 yields the expression for N^* in (15.a). While the first two terms correspond to revenues obtained from manufacturer j the last term corresponds to revenues obtained from direct sale to customers of i who install a second browser themselves.

When $t_2 < k$ the derivation for N^* is simpler since the revenues that accrue to Netscape are all obtained from the agreement with manufacturer *j*. Q.E.D.

Proof of Observation 2

Substituting into (17) and (18), symmetry as well as $r_T = r_W$ yields:

(A.3)

$$D \equiv (S_i - S_i^*) + (N - N^*) = \begin{cases} \dfrac{(t_2+k)(3t_2-k)\left(t_1 - \dfrac{r_N}{2}\right)}{32t_1t_2} - \dfrac{(t_2-k)^2}{8t_2}\left(\dfrac{1}{2} - \dfrac{(t_2+k)}{4t_1}\right) & \text{when } t_2 \geq k \\ \dfrac{t_2}{8t_1}\left(t_1 - \dfrac{r_N}{2}\right) & \text{when } t_2 < k \end{cases}$$

The solution for r_N as implied by (17) and (18) is

(A.4)

$$r_N = \begin{cases} \dfrac{(t_2+k)(3t_2-k)(1-l_2)}{8t_2} + \dfrac{l_2(t_2-k)^2}{2t_2}\left(\dfrac{1}{2} - \dfrac{(t_2+k)}{4t_1}\right) \\ \hline \left[1 - \dfrac{(1+l_2)(t_2+k)(3t_2-k)}{16t_1t_2}\right] \end{cases} \quad \text{when } t_2 \geq k$$

$$\frac{2t_1t_2(1-l_2)}{[4t_1 - t_2(1+l_2)]} \quad \text{when } t_2 < k$$

Substituting (A.4) into (A.3) yields that the surplus in the negotiations with Netscape is positive (i.e., D > 0) if:

$$\frac{(t_2+k)(3t_2-k)}{32t_2}\left[1 - \frac{(t_2+k)(3t_2-k)}{8t_1t_2}\right] - \frac{(t_2-k)^2}{16t_2}\left(1 - \frac{(t_2+k)}{2t_1}\right)\left(1 - \frac{(t_2+k)(3t_2-k)}{16t_1t_2}\right) > 0$$

when $t_2 \geq k$ and

$$\frac{t_2}{8}\left[\frac{4t_1 - 2t_2}{4t_1 - t_2(1+l_2)}\right] > 0$$

when $t_2 < k$. It is negative otherwise. The regions specified in the Observation follow from the above expressions. Q.E.D.

Proof of Proposition 1

Setting the difference $\Delta = r_T - r_W$ so that $D = 0$ yields:

When $t_2 \geq k$

$$(r_T - r_W)\left(\frac{1}{4} - \frac{(t_2+k)(3t_2-k)}{64t_1t_2}\right) = \frac{r_N}{2}\frac{(t_2+k)(3t_2-k)}{32t_1t_2} - \frac{(t_2+k)(3t_2-k)t_1}{32t_1t_2} + \frac{(t_2-k)^2}{8t_2}\left(\frac{1}{2} - \frac{t_2+k}{4t_1}\right)$$

and when $t_2 < k$:

$$\frac{(r_T - r_W)}{4}\left(1 - \frac{t_2}{4t_1}\right) = \frac{r_N t_2}{16t_1} - \frac{t_2}{8}.$$

Substituting for $(r_T - r_W)$ into equations (17) and (18) yields the solution for r_N as specified in the Proposition.

From the first order condition (12) it follows that the profits of Microsoft are given by

(A.5)

$$M = \frac{r_T + r_W}{2} = p_S - \frac{r_N}{2} - t_1,$$

where p_S solves equation (13). Substituting for p_S into (A.5) yields Microsoft's payoff at the non-exclusionary equilibrium. Q.E.D.

Proof of Proposition 2

When Netscape is foreclosed from the market the disagreement payoff of Microsoft in the negotiations with manufacturers i changes from (6) to

$$M^* = \left(\frac{v}{t_1} - \frac{t_2}{2t_1} - \frac{p_S^j}{t_1}\right) r_T^j,$$

since each consumer incurs higher expected transportation costs given the reduced choice among browsers. The solution for p_S is obtained very similarly to the derivation in (13). The modifications are implied by the different disagreement payoff M^* and the fact that no negotiations with Netscape take place so that $r_N = 0$. The profits of Microsoft are obtained from (12) by substituting $r_N = 0$. Q.E.D.

Proof of Proposition 3

It follows by direct comparison of the payoffs of the two previous propositions.

Proof of Proposition 4

The profit of Microsoft at the non-exclusionary equilibrium is given by:

$$M_{NE} = \frac{\left(v - \frac{t_2}{4} - 2t_1 - \frac{r_N}{2}\right) + \sqrt{\left(v - \frac{t_2}{4} - 2t_1 - \frac{r_N}{2}\right)^2 + \frac{(1-l_1)}{2\,l_1} 4t_1^2}}{2}.$$

With explicit exclusionary clauses these profits change to:

$$M_E = \frac{\left(v - \frac{t_2}{2} - 2t_1\right) + \sqrt{\left(v - \frac{t_2}{2} - 2t_1\right)^2 + \frac{(1-l_1)}{2\,l_1} 4t_1^2}}{2}.$$

It is easy to demonstrate that $M_{NE} > M_E$ provided that $r_N < t_2/2$. The expressions derived for r_N are smaller provided that t_2 is small and/or λ_2 is large. Q.E.D.

Proof of Lemma 3

Obtained by optimizing S_i with respect to p_S^i and upon substitution of symmetry and (20). Q.E.D.

Proof of Proposition 5

When $t_2 \geq k$

$$\left[S_i - S_i^* + N - N^*\right] = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1}\right)\frac{\left(r_T^i - r_W^i\right)}{2} + \frac{(t_2+k)(3t_2-k)\left(p_S^i - r_T^i\right)}{16 t_1 t_2}$$

$$- \frac{(t_2-k)^2}{8}\left(\frac{v}{t_1} - \frac{p_S^i}{t_1} - \frac{t_2}{4t_1} - \frac{3(t_2+k)}{8t_1}\right)$$

Substituting symmetry as well as the expression derived in Lemma 3 yields:

$$\left[S_i - S_i^* + N - N^*\right] = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{r_N}{2t_1}\right)\frac{l_1}{1+l_1}\frac{\Delta}{2} + \frac{(t_2+k)(3t_2-k)}{16t_1t_2}\left[\frac{l_1}{1+l_1}\left(v - \frac{t_2}{4}\right)\right.$$

$$\left. + \frac{r_N}{2(1+l_1)} + \frac{\Delta}{2}\right] - \frac{(t_2-k)^2}{8t_2}\left[\left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{r_N}{2t_1}\right)\frac{l_1}{1+l_1} - \frac{3(t_2+k)}{8t_1}\right],$$

where $\Delta = (r_T - r_W)$.

The above combined surplus is the smallest when $\Delta = 0$. However, even then the surplus is strictly positive (assuming an interior equilibrium with positive market shares for each producer.)

When $t_2 < k$

$$\left[S_i - S_i^* + N - N^*\right] = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1}\right)\frac{\left(r_T^i - r_W^i\right)}{2} + \frac{t_2}{4t_1}\left(p_S^i - r_T^i\right),$$

which is, once again, strictly positive even when $\Delta = 0$. Q.E.D.

Proof of Proposition 6

In the absence of exclusivity clauses, Microsoft's profits are given from Lemma 3 as:

$$M_{NE} = \frac{2\,l_1(1-l_1)}{t_1(1+l_1)^2}\left(v - \frac{t_2}{4} - \frac{r_N}{2}\right)^2,$$

where subscript NE corresponds to non-exclusion.

With explicit exclusivity contracts, the following are the agreement and disagreement payoffs in the negotiations between Microsoft and manufacturer *i*:

$$S_i = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1} - \frac{R(t_2,k)}{t_1} \right) \left(p_S^i - r_T^i \right)$$

$$M = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^i}{t_1} - \frac{R(t_2,k)}{t_1} \right) r_T^i + \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^j}{t_1} - \frac{R(t_2,k)}{t_1} \right) r_T^j$$

$$S_i^* = 0$$

$$M^* = \left(\frac{v}{t_1} - \frac{t_2}{4t_1} - \frac{p_S^j}{t_1} - \frac{R(t_2,k)}{t_1} \right) r_T^j$$

The Nash Bargaining Solution satisfies:

$$(1 - l_1)(S_i - S_i^*) - l_1 (M - M^*) = 0$$

This together with the optimization of S_i with respect to p_S^i yields at the symmetric equilibrium:

$$r_T = \frac{(1 - l_1)}{(1 + l_1)} \left(v - \frac{t_2}{4} - t_1 R(t_2,k) \right)$$

and profits to Microsoft are equal to:

$$M_E = \frac{2 l_1 (1 - l_1)}{(1 + l_1)^2 t_1} \left[v - \frac{t_2}{4} - R(t_2,k) \right]^2 .$$

The Proposition follows by comparing M_{NE} with M_E. Q.E.D.