

CONSUMER SWITCHING COSTS AND OPTIMAL ANTITRUST POLICY

by

Michael Waldman
Johnson Graduate School of Management
Cornell University
Sage Hall
Ithaca, NY 14853
(607) 255-8631, mw46@cornell.edu

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ABSTRACT

Most standard conclusions in antitrust are based on models without switching costs, but consumer switching costs are important in many real-world settings. In this paper I argue that this is an important omission because the inclusion of switching costs can change the conclusions concerning optimal antitrust policy in various settings. I illustrate this by discussing two issues – aftermarket monopolization and the tying of complementary products. In the first the inclusion of switching costs results in the non-standard conclusion that aftermarket monopolization is beneficial. In the second including switching costs causes tying to be used for socially harmful purposes in a broader range of circumstances than captured by the previous literature. In each case I provide a discussion of the conclusions that can be drawn for antitrust policy.

I. INTRODUCTION

There are a number of standard results concerning how markets operate that translate into standard conclusions concerning optimal antitrust policy. For example, it is thought that in most cases competition results in efficient outcomes and so antitrust policy should in general support competitive markets. Many of these results, however, are derived in models that lack consumer switching costs, but consumer switching costs are present in an important fashion in many real-world settings. In this paper I argue that this is an important omission. Specifically, I argue that the inclusion of consumer switching costs frequently results in changed conclusions concerning whether specific behaviors result in efficient or inefficient outcomes, so optimal antitrust policy can be quite different when consumer switching costs are incorporated into the analysis.

As indicated, most standard models concerning market behavior do not include consumer switching costs.¹ This means that when in any period t a consumer thinks about what products to consume, the consumer's preferences across different brands are not affected by the consumer's prior consumption choices. But this does not accurately reflect the situation in many important real-world settings. For a variety of reasons switching costs are important in many real-world settings which means that in any specific period a consumer prefers to consume the same brand of product he or she consumed in the previous period. For example, if in the last period a consumer learned word processing using Word 2002 rather than Word Perfect 11, then in the current period the consumer will typically prefer Word 2003 over Word Perfect 12 because of the similar ways in which Word 2002 and Word 2003 operate.²

In this paper I consider the ramifications in terms of social welfare and antitrust policy of incorporating consumer switching costs into the analyses of two distinct and important settings. The first setting concerns aftermarket behavior. There are various cases both in the United

¹ There is an extensive literature that investigates models characterized by consumer switching costs. Papers in this literature include Klemperer (1987,1989) and Farrell and Shapiro (1988,1989). See Klemperer (1995) for a survey.

² There are various reasons in addition to learning-by-doing for the existence of consumer switching costs such as complementarities with the stock of durables held by consumers, transactions costs of finding new suppliers, and psychological costs of switching brands. See Klemperer (1995) for a discussion.

States and elsewhere in which a durable-goods producer is alleged to have monopolized an aftermarket associated with its own durable products. For example, in the famous US Supreme Court case *Eastman Kodak Company v. Image Technical Services, Inc., et al.*, (1992), the allegation was that Kodak illegally monopolized the maintenance market for its own durable products by refusing to sell spare parts to alternative maintenance suppliers. The other interesting aspect of this case is that the courts ruled that Kodak had no market power in the market for new durable units, so the antitrust issue faced by the US Supreme Court was whether a firm with no market power in the sale of a new durable product could be in violation of antitrust rules by monopolizing a related aftermarket.

Most analyses of this issue both during the case and soon after did not incorporate consumer switching costs. As a result, the debate mostly focused on whether the practice was socially harmful or had no effect on social welfare.³ Those who argued it was harmful focused primarily on hold-up arguments. For example, Borenstein, Mackie-Mason, and Netz (1995) argue that competitive durable-goods producers would like to commit not to monopolize the maintenance market, but because of an inability to commit monopolization takes place and social welfare falls because of a standard deadweight loss due to the monopoly pricing of maintenance. In contrast, Shapiro (1995) argues that, because of reputational considerations, even after monopolization a competitive price will be charged for maintenance so the monopolization has no effect on welfare. Note that faced with a debate wherein the practice either harmed welfare or left it unchanged, the Supreme Court ruled that the practice was indeed a potential antitrust violation. Given the arguments presented, this ruling makes sense since at worst making the practice illegal should have left welfare unchanged.

But in fact there is substantial evidence that consumer switching costs were important in the Kodak case and the social-welfare implications of aftermarket monopolization are quite

³ A few papers do put forth efficiency rationales for the practice. For example, Chen and Ross (1999) consider a setting in which free maintenance is bundled with the sale of new durable units and aftermarket monopolization both stops the subsidization of heavy users by light users and also improves welfare by moving maintenance choices toward efficient levels.

different in the presence of consumer switching costs.⁴ When switching costs are present a competitive maintenance market is itself not efficient. The reason is that the presence of switching costs creates market power in the market for replacement durable units, so when making the decision whether to maintain or replace a used machine a competitive price for maintenance will cause some consumers to inefficiently substitute maintenance for replacement. In this setting monopolizing the maintenance market allows the original durable-goods producer to eliminate the replacement/maintenance distortion and, if the original durable-goods market is competitive, eliminating this distortion improves both social welfare and consumer welfare. In other words, making the analysis more realistic by incorporating consumer switching costs yields the conclusion that the US Supreme Court had it exactly wrong – Kodak’s aftermarket monopolization should have been allowed because, given the presence of consumer switching costs, the practice likely improved rather than hurt both social welfare and consumer welfare.

The second setting I consider is the tying of a complementary good to a monopolized primary good. Authors associated with the Chicago School have argued that a monopolist of a primary good would never tie a complementary good to the primary good in order to extend its monopoly power (see, for example, Director and Levi (1956), Bowman (1957), Posner (1976), and Bork (1978)). Their rationale was that the monopolist could capture all of the potential monopoly profits associated with the complementary product through the sale of the monopolized primary product, so tying is not needed. In an important paper, Whinston (1990)

⁴ The allegations in the Kodak case discuss the idea that consumers faced substantial switching costs. For example,

“The system at CSC includes a combination of micrographics machines, and of computer hardware and software tailored specifically to CSC’s needs. Trading its entire equipment for an “interbrand” competitor of Kodak, due to supra-competitive prices, it would be financially unfeasible for CSC. The specific software would have to be retailored at a cost of several hundred thousand dollars. Data would have to be reformatted and operators would have to be retrained, again, at a cost of hundreds of thousands of dollars...”

(Plaintiff’s Memorandum in *Eastman Kodak Co. v. Image Technical Services, Inc., et al.*, (1992), pp. 19-20)

The allegations in the case also state that similar systems to the one described were true for a variety of the firm’s customers such as “Blue Cross/Blue Shield, insurance companies, banks, and other large financial institutions in many states.” (Plaintiff’s Memorandum in *Eastman Kodak Co. v. Image Technical Services, Inc., et al.*, (1992), p.19)

showed that this is not generally the case, but he argued that it is correct in an important class of settings. That is, in a somewhat general model Whinston showed that if the monopolist's primary good is essential, i.e., the primary good is required for all uses of the complementary good, then tying cannot increase monopoly profits.⁵

But Whinston's analysis does not incorporate consumer switching costs and in the presence of consumer switching costs tying can be used to extend monopoly power even when the monopolist's primary good is essential. Consider a two-period durable-goods setting in which in each period individuals consume systems consisting of one primary unit and one complementary unit, where the primary product is sold or leased only by the monopolist while the complementary product is sold or leased both by the monopolist and a single alternative producer. Further, suppose that in the second period each firm can upgrade its complementary good and there are switching costs for the complementary good. Then, even though the monopolist's primary good is essential for consumption in both periods, for some parameterizations the only way that the monopolist can capture the value associated with the complementary-good switching costs is for individuals to consume the monopolist's complementary product in the first period, and the only way that the monopolist can ensure this is by tying its primary and complementary goods. In other words, in the presence of consumer switching costs, a monopolist may tie in order to extend its market power to the tied-good market in a broader set of circumstances than previously realized.

In summary, the standard analyses that most of antitrust are based on do not incorporate consumer switching costs and this is an important omission. Switching costs are pervasive and the incorporation of switching costs can radically change the conclusions of standard analyses. The presence of switching costs means that market power is created endogenously by the prior

⁵ Whinston showed that the Chicago School argument may not hold when the primary good is not essential. For example, suppose there is a use of the complementary good that does not require the primary good and there are economies of scale in the production of the complementary good. Then tying can be optimal by causing the exit of alternative producers of the complementary good which, in turn, allows the monopolist to capture monopoly profits when it sells complementary units that are employed in the use that does not require the primary good. This argument is discussed in more detail in Section IV.

consumption decisions of consumers, and this creation of market power has important implications for the proper interpretation of various behaviors such as aftermarket monopolization and the tying of complementary goods. Thus, in deciding upon optimal antitrust policy in various real-world cases it is important for the antitrust authorities first to identify whether switching costs are present in a significant way, and second, if they are, to correctly analyze the implications switching costs have for the proper interpretation of firm behavior.

The outline for the paper is as follows. Section II discusses aftermarket monopolization and, in particular, the idea that the introduction of consumer switching costs changes the motivation and implications of aftermarket monopolization in a setting in which there is competition in the sale of the initial durable product. Section III discusses the tying of complementary products and, in particular, the sense in which the incorporation of consumer switching costs expands the set of circumstances in which a monopolist may tie a complementary good in order to extend its market power to the complementary-good market. Section IV discusses my views of optimal antitrust policy for aftermarket monopolization and the tying of complementary products given earlier results concerning consumer switching costs. Section V presents concluding remarks.

II. SWITCHING COSTS AND AFTERMARKET MONOPOLIZATION

In this section I discuss how the introduction of consumer switching costs changes the ramifications of aftermarket monopolization in a setting characterized by competition for new durable units. The first subsection describes an infinite-period competitive durable-goods model in which used units require maintenance. The second subsection then describes equilibrium outcomes with and without consumer switching costs. The main point is that with consumer switching costs aftermarket monopolization improves welfare, while this is not the case in the absence of switching costs. The third subsection considers two extensions of the basic analysis.⁶

⁶ More formal analyses that capture the ideas contained in this section appear in Carlton and Waldman (2003) and Morita and Waldman (2005).

The analysis that follows builds on the earlier work of Schmalensee (1974), Su (1974), and Rust (1986). Those papers consider durable-goods monopoly models characterized by a competitive maintenance industry. In their analyses, because new durable units are sold at a price above marginal cost due to monopoly while maintenance is priced at marginal cost due to competition, consumers sometimes inefficiently substitute maintenance for the replacement of used durable units. In the following analysis a similar result arises even though the model is characterized by perfect competition for the production of new durable units. That is, because of consumer switching costs and the resulting market power in the replacement-unit market, the second-period price for replacement units is above marginal cost. The result is that, as in the earlier papers of Schmalensee, Su, and Rust, in the second period some consumers maintain used durable units that would be more efficiently replaced.

A) The Model

Consider an infinite-period model in which there is perfect competition both in the market for new durable units and in the market for maintenance. Each durable-goods producer has a constant marginal cost of production equal to c and no fixed costs, while each maintenance producer can produce m units of maintenance at a cost of m . Further, each durable-goods producer has the ability to provide maintenance for its own durable units where, just as for the competitive maintenance producers, each firm has a cost of m for producing m units of maintenance. Note that, because the maintenance industry is competitive, the fact that a firm can produce m units of maintenance at a cost of m means that, if allowed, a consumer can purchase m units of maintenance from a firm in the competitive maintenance industry at a price equal to m . Also, a durable unit lasts two periods, where a new unit requires no maintenance while the maintenance required by a used unit is stochastic and is described below.

On the demand side, I assume a continuum of consumers born in the first period whose total mass is normalized to one, where each consumer lives infinitely long and consumers are assumed to be heterogeneous in their valuations for the durable product. Specifically, in the first

period each consumer i has a gross valuation equal to v_i for the consumption of a unit of the durable product, where the v_i s in the population are described by a density function $f(v_i)$. Further, it is assumed that $f(v_i) > 0$ for all v_i in the interval $[0, V]$, $V > c$, and $f(v_i) = 0$ for all v_i outside of this interval.

The specification for consumer utility in later periods is more complicated because of consumer switching costs and maintenance requirements for used units. Let Δ denote the size of the consumer switching costs and let j_{it} be the producer of the durable unit consumed by individual i in period t . Also, z_{it} is the realization of the stochastic maintenance requirement for the used unit owned by consumer i at the beginning of period t , where z_{it} is drawn from a density function $g(z)$, $g(z) > 0$ for all $0 < z < \infty$, and $g(z) = 0$ for all z outside of this interval. Also, the realization of z_{it} is privately observed by consumer i at the beginning of period t .

There are four possibilities concerning what happens in period t , $t \geq 2$. First, the consumer receives a gross benefit of $v_i + \Delta$ from consuming a new durable unit produced by firm j_{it-1} . Second, the consumer receives a gross benefit of v_i from consuming a new unit produced by another manufacturer. Third, he receives a gross benefit of $v_i + \Delta$ (0) from consuming the used unit he owned at the beginning of period t given he purchases at least (less than) z_{it} units of maintenance. Fourth, if the consumer did not consume a new or used unit in the previous period, then he receives a gross benefit of v_i from consuming a new unit produced by any manufacturer. It is also assumed that all firms and consumers are risk neutral and have a discount factor β , $0 < \beta < 1$.⁷

The timing of moves in the game is as follows. The first period consists of two stages. First, each durable-goods producer chooses the price at which it will sell a new unit of output. Second, each consumer makes his purchase decisions. Each succeeding period then consists of the following three stages. First, if monopolizing the maintenance market is an option, each durable-goods manufacturer chooses whether or not to monopolize the maintenance market for

⁷ To simplify the analysis no secondhand-market trade is allowed. This has no effect on the qualitative nature of the results.

its own product. Second, each durable-goods manufacturer chooses the price at which it will sell a new unit of output and, if the firm has decided to monopolize the maintenance market, a price schedule for maintenance. Third, each consumer makes his purchase decisions. Throughout the analysis I focus on Subgame Perfect Nash Equilibria.

B) Analysis

I will start by describing the results of a benchmark analysis which concerns what happens in this model in the absence of consumer switching costs, i.e., $\Delta=0$. Suppose $\Delta=0$ and durable-goods producers are prohibited from monopolizing the maintenance markets for their own products. Then the outcome is a first-best result. Specifically, because there is competition in each period t , $t \geq 2$, for both replacement machines and maintenance, all firms charge c for replacement units and maintenance of level m costs m . In turn, facing prices for replacement units and maintenance that reflect their true costs, consumers make efficient choices concerning whether to maintain or replace their used units. In particular, there are critical values v^* and z^* such that, if $v_t > v^*$ and the consumer owns a used unit at the beginning of period t , then the consumer maintains the used unit he owns at the beginning of the period when $z_{it} \leq z^*$ and replaces it with a new unit when $z_{it} > z^*$.⁸

Now suppose $\Delta=0$ but durable-goods producers are allowed to monopolize the maintenance markets for their own products at the beginning of each period. The first result in this case is that any firm that sells new durable units in period t will choose to monopolize the maintenance market for its own product in period $t+1$. The logic here is straightforward. If the firm does not monopolize the maintenance market, then from earlier we know that the firm will sell new units at price of c in period $t+1$ and thus profits in period $t+1$ equal zero. In contrast, by monopolizing the maintenance market the firm can earn expected profits that are strictly

⁸ It is assumed that a consumer who is indifferent between maintaining and replacing a used unit chooses to maintain it. This assumption is not at all essential for the qualitative nature of the results.

positive by charging a price above cost for low levels of maintenance and in this way capture some of the surplus associated with low realizations for the required maintenance level.

The second result in this case is that this aftermarket monopolization does not affect social welfare or consumer welfare. There are two steps to the argument. First, although the firm raises the maintenance price for low values for the required maintenance level, it would never raise the price so high that a consumer for whom it is efficient to maintain his used unit chooses to replace rather than maintain the unit. Second, because the market for new durable units is competitive, we know consumers receive all the societal surplus. Hence, given that the maintenance/replacement decision is made efficiently, it must be the case that both social welfare and consumer welfare are the same as when the maintenance market was competitive.

Now consider what happens when switching costs are introduced. As in the benchmark case above, I again start by considering what happens when aftermarket monopolization is not allowed. As opposed to what was true in the benchmark analysis, in the presence of consumer switching costs the absence of aftermarket monopolization does not result in a first-best outcome. To see this, consider a firm that sells a positive number of new units in the first period. Given switching costs and that a competitive maintenance market means that maintenance will be priced at cost in all periods, efficient consumer choices require the firm to charge c for new units in all periods. But this would result in zero profits for the firm in each period and we know that the firm can earn positive expected profits starting in the second period by pricing new units at least a little above marginal cost and capturing some of the surplus associated with the consumer switching costs. The end result is that social welfare and consumer welfare are lowered because, in response to the above marginal cost price for new units after the first period, some consumers will inefficiently substitute maintenance of used units for the replacement of those units.

Now suppose aftermarket monopolization is allowed. Similar to how the benchmark analysis worked, any firm that sells new units in the first period will choose to monopolize the maintenance market for its own product starting in the second period. The reasons are that

choosing to monopolize the maintenance market allows the firm to more effectively exploit the market power it has with its repeat customers due to the consumer switching costs and also allows the firm to extract some of the surplus associated with low realizations for required maintenance. However, in contrast to what was true in the benchmark analysis which lacked consumer switching costs, the aftermarket monopolization now increases social welfare. The logic here is that when the firm monopolizes the maintenance market it has an incentive to set prices that extract all the potential surplus associated with both the switching costs and low realizations for z_{it} . Since this surplus is higher when consumers make efficient maintenance decisions, the firm sets prices that eliminate the distortion found in the benchmark case. In turn, the elimination of this distortion means that social welfare is increased.

One interesting aspect of this result is that it is not only social welfare that unambiguously increases due to the aftermarket monopolization, but rather consumer welfare also unambiguously increases. The logic here is as follows. We know that in a competitive environment firms earn zero profits in equilibrium so all of the social surplus is received by consumers, i.e., consumer welfare and social welfare are equivalent. In other words, since in the model considered the durable-goods market and the maintenance market are both competitive, the increase in social welfare associated with aftermarket monopolization is equivalently an increase in consumer welfare.

Overall, this subsection shows that the introduction of consumer switching costs has a significant impact on the social-welfare implications of aftermarket monopolization in a setting in which the durable-goods market is competitive. In the absence of consumer switching costs, both competitive maintenance and aftermarket monopolization result in a first-best result. In contrast, in the presence of consumer switching costs, aftermarket monopolization eliminates a social-welfare distortion concerning the maintenance versus replacement decision so the result is increased social welfare. Clearly, the introduction of consumer switching costs has important implications for optimal antitrust policy concerning aftermarket monopolization. I come back to this issue in Section IV.

C) Extensions

In this subsection I consider two extensions of the model considered in the previous subsection. The first extension concerns why firms would monopolize the maintenance markets for their own products rather than increase the price for spare parts, while the second concerns why firms would monopolize the maintenance markets for their own products rather than sign long-term contracts that specify future prices for replacement units.

i) *Why Not Increase the Price for Spare Parts?*

One interesting question concerning the Kodak case and other cases in which maintenance-market monopolization has been alleged concerns the manner in which the monopolization is achieved. Specifically, in many of the cases the allegation is that the firm achieved monopolization by refusing to sell spare parts to alternative maintenance providers. But this raises the question, why doesn't the firm simply raise the price for spare parts rather than refuse to sell spare parts and in this way monopolize the maintenance market? In this discussion I address this question. Specifically, I incorporate spare parts into the analysis and argue first that durable-goods producers prefer to monopolize the maintenance markets for their own products rather than increase the price for spare parts, and second that social welfare and consumer welfare are higher with monopolization.

Consider the model presented and analyzed in the previous subsections but now assume that when a durable unit becomes used it requires maintenance consisting of one unit of service and a stochastic number of spare parts, where the original producer of the durable unit is the sole producer of spare parts for that unit. There are no fixed costs for producing either parts or service, while a durable-goods producer has a constant marginal cost of c_R , $c_R > 0$, for producing spare parts and every firm has a constant marginal cost of c_S , $c_S > 0$, for providing service. Further, similar to the informational assumptions of the basic model, it is assumed that a

consumer who owns a used unit at the beginning of a period privately observes the number of replacement parts required by the unit.

As indicated above, the question is, will durable-goods producers choose to monopolize the maintenance markets for their own products by refusing to sell spare parts to alternative maintenance suppliers or will firms simply raise the price for spare parts?⁹ Analysis of this model yields that firms choose the first of these two options. A firm's motivation for choosing this option is that this choice maximizes the firm's profitability in the period in which the choice is made. However, given durable-goods producers earn zero profits overall due to competition, the end result of this choice is not increased firm profitability but rather increased consumer and social welfare.

The logic here is as follows. In this model, consumer welfare and social welfare are maximized when, at the time of the maintenance/replacement decision, each durable-goods producer is able to perfectly price discriminate. The advantage of perfect price discrimination is that it means that at that date the firm is capturing all of the available surplus which, in turn, means that the firm has an incentive to have the maintenance/replacement decision chosen efficiently. Further, the efficiency associated with perfect price discrimination increases social welfare and, given competition ensures durable-goods producers earn zero profits overall, it must also increase consumer welfare.

Now consider a firm's ability to perfectly price discriminate. Consider two different realizations for the number of spare parts required, each of which is sufficiently low that it is efficient for a consumer to maintain the used unit rather than to replace it. Perfect price discrimination requires that the full maintenance price not vary across these two different realizations for the number of spare parts required. If the durable-goods producer refuses to sell spare parts and monopolizes the maintenance market, then it can directly set maintenance prices

⁹ If a firm offers to sell spare parts but sets a prohibitively high price on the parts, then I will say that the firm has chosen to monopolize the maintenance market for its own product.

that are the same for these two realizations. However, if all the firm does is raise the price for spare parts, then the competitive maintenance producers will charge more for maintenance that requires more spare parts. Hence, only by monopolizing the maintenance market can durable-goods producers perfectly price discriminate, so this is the option chosen and the result is higher consumer and social welfare.

ii) *Why Not Long-Term Contracts?*

In the main analysis of this section it was assumed that a durable-goods producer could not commit to future prices for replacement units. But suppose instead that such long-term commitments were feasible. Then firms would not need to monopolize the maintenance markets for their own used units to achieve a first-best outcome. Rather, in that case, when first selling new durable units a firm could ensure a first-best outcome by committing to sell replacement units in all future periods at marginal cost. The logic here is that, if the firm commits to future prices equal to marginal cost, then in the absence of maintenance-market monopolization consumers face marginal cost pricing for both maintenance and replacement units and so make efficient decisions concerning whether to maintain or replace used units.

So the question is, why would durable-goods producers choose to monopolize the maintenance markets for their own products rather than sign long-term contracts that specify future prices for replacement units? To address this question, consider the following variant of the basic model analyzed in this section. Everything is the same as in that basic model, except now at the beginning of the first period each durable-goods producer makes a once and for all choice of the durability of its product, where an increase in durability both increases the marginal cost of production and decreases the expected maintenance requirement for used units. Also, a firm's choice of durability in the first period is neither publicly observable nor verifiable which introduces a standard moral-hazard problem concerning the choice of durability.

Analysis of this model yields that in equilibrium durable-goods producers will choose to monopolize the maintenance markets for their own products rather than offer long-term contracts

that specify the future prices for replacement units. To see why, consider first what would happen if durable-goods producers chose to offer long-term contracts in the first period. For long-term contracts to achieve the efficient outcome the contracts would need to specify future prices for replacement units equal to the marginal cost of production associated with the first-best choice of durability. But suppose that in the first period durable-goods producers offered such contracts. Then, starting in the second period, if a durable-goods producer had chosen the first-best durability level in the first period, the firm's expected profits would equal zero. But the firm's profits starting in the second period would be higher if the firm had instead chosen lower durability in the first period. In other words, long-term contracts cannot be used to achieve a first-best outcome, so when durable-goods producers offer long-term contracts social welfare is below the first-best level and there is a resulting decrease in consumer welfare.

Now suppose that durable-goods producers do not offer long-term contracts but instead monopolize the maintenance markets for their own products. Then, starting in the second period, by optimally setting prices for maintenance and replacement units a durable-goods producer would be able to extract all the available surplus. In turn, given that it is able to extract all the available surplus, the firm will choose the first-best durability level in the first period. In other words, when durable-goods producers monopolize the maintenance markets for their own products there is no distortion either in terms of the maintenance/replacement decision or the durability decision, so equilibrium is characterized by maintenance-market monopolization because this choice results in first-best social welfare and higher consumer welfare.

III. SWITCHING COSTS AND THE TYING OF COMPLEMENTARY PRODUCTS

In this section I discuss how the introduction of consumer switching costs changes our understanding of the settings in which a durable-goods monopolist will tie a complementary good in order to extend its market power to the complementary-good market. The first subsection describes a two-period durable-goods model in which there is a complementary good that can be produced either by the monopolist or by a single alternative producer. The second

subsection then describes what happens in this setting with and without consumer switching costs. The main point of the discussion is that in the absence of consumer switching costs the monopolist does not have an incentive to tie while with switching costs it can, where this tying behavior frequently reduces social welfare.¹⁰

The analysis in this section contributes to a growing literature that shows the limitations of the Chicago School argument that a monopolist of a primary good would never tie a complementary good in order to extend its market power to the complementary-good market. In an important paper, Whinston (1990) shows that this argument is not correct if there is a use for the complementary good that does not require the monopolist's primary good, but if the primary good is essential then the Chicago School argument holds (other important papers in this literature include Choi and Stefanadis (2001), Carlton and Waldman (2002), and Nalebuff (2004)). In this section I argue that even Whinston is wrong concerning the validity of the Chicago School argument when consumer switching costs are introduced. That is, in a durable-goods setting with consumer switching costs, a monopolist may tie a complementary good to an essential primary good in order to extend its market power to the complementary-good market.

A) The Model

Consider a two-period model in which there is a monopolist of a primary good while both the monopolist and a single alternative producer can produce a good that is complementary to the primary good. The primary good is durable and does not depreciate with age, where the monopolist has a constant marginal cost of c_P for producing the primary good. A basic complementary unit is also durable and does not depreciate with age, where both the monopolist and the alternative producer have a constant marginal cost of c_C for producing basic complementary units. Further, it is assumed that the alternative producer's basic complementary product is superior to the monopolist's.

¹⁰ A more formal analysis that captures the ideas contained in this section appears in Carlton and Waldman (2005a).

In addition to basic complementary units, both the monopolist and the alternative producer can produce upgraded complementary units in the second period.¹¹ Specifically, at the beginning of the second period each firm has the option of investing R in research and development, where investing gives the firm the ability to produce upgraded or superior quality complementary units in the second period. Given it has invested R , a firm has a constant marginal cost of producing upgraded complementary units in the second period also equal to c_C . Further, similar to what was true for the basic complementary good, the alternative producer's upgraded complementary good is superior to the monopolist's.

Now consider the demand side of the model. There are N identical consumers who live two periods.¹² In the first period a consumer's gross benefit from consumption is straightforward. The consumer receives a gross benefit of V_M , $V_M > c_P + c_C$, from consuming a system consisting of one unit of the monopolist's primary good and one unit of the monopolist's complementary good. Similarly, the consumer receives a gross benefit of V_A , $V_A > V_M$, from consuming a system consisting of one unit of the monopolist's primary good and one unit of the alternative producer's complementary good. Further, the consumer receives zero gross benefits from consuming either a primary unit or a complementary unit by itself. Note that the assumption $V_A > V_M$ captures the idea that the alternative producer's complementary good is superior to the monopolist's.

The specification for consumer utility in the second period is a bit more complicated because of the switching costs and the possibility that one or both firms invest in research and development and then produce upgraded complementary units in the second period. Consider first an individual who consumed a system in the first period containing the monopolist's complementary good. There are four possibilities. First, he could consume a system consisting

¹¹ Previous papers on upgrading in durable-goods markets include Waldman (1996), Fudenberg and Tirole (1998), and Lee and Lee (1998).

¹² By assuming consumers are identical, I abstract away from the durable-goods time-inconsistency problem that has been investigated in a variety of papers such as Coase (1970), Bulow (1982), and Waldman (1993). See Waldman (2003) for a discussion of that literature.

of the monopolist's primary good and the monopolist's basic complementary good and receive a gross benefit equal to $V_M + \Delta$, where Δ represents the value due to the switching cost. Second, he could consume a system consisting of the monopolist's primary good and the monopolist's upgraded complementary good and receive a gross benefit equal to $V_M + \Delta + \lambda$, where λ represents the value of the upgrade. Third, he could consume a system consisting of the monopolist's primary good and the alternative producer's basic complementary good and receive a gross benefit of V_A . Fourth, he could consume a system consisting of the monopolist's primary good and the alternative producer's upgraded complementary good and receive a gross benefit of $V_A + \lambda$. Also, as in the first period, he receives zero gross benefits from consuming either a primary unit or a complementary unit by itself.

Now consider an individual who consumed a system in the first period containing the alternative producer's complementary good. There are again four possibilities, where the gross benefits here are symmetric to the ones given above. First, he could consume a system consisting of the monopolist's primary good and the monopolist's basic complementary good and receive a gross benefit equal to V_M . Second, he could consume a system consisting of the monopolist's primary good and the monopolist's upgraded complementary good and receive a gross benefit equal to $V_M + \lambda$. Third, he could consume a system consisting of the monopolist's primary good and the alternative producer's basic complementary good and receive a gross benefit of $V_A + \Delta$. Fourth, he could consume a system consisting of the monopolist's primary good and the alternative producer's upgraded complementary good and receive a gross benefit of $V_A + \Delta + \lambda$. Also, as in the other cases, he receives zero gross benefits from consuming either a primary unit or a complementary unit by itself. Note that, since in each period a consumer derives no utility from consuming a complementary unit by itself, in this model the monopolist's primary product is essential for all uses of the complementary product in both periods.¹³

¹³ A third case concerns what happens in the second period when the individual did not consume a system in the first period. The gross benefits here are the same as in either of the other two cases except there are no switching-cost terms.

I assume Bertrand competition when more than one firm is active in the market, but in this model Bertrand competition does not always result in a unique set of prices. For example, suppose both firms lease their products, all consumers in the first period lease the alternative producer's complementary good, and both firms upgrade their complementary product at the beginning of the second period. Then there are multiple equilibria to the second-period pricing game, where the equilibria vary in terms of the division of the surplus associated with the alternative producer's upgraded complementary product. Following the approach taken in Carlton and Waldman (2002), it is assumed that when this indeterminacy problem arises in the second period the prices that emerge evenly divide the surplus across the two sellers (one interpretation of this assumption is that prices are determined by the Nash bargaining solution – see Nash (1950)).

To complete the set-up of the model, the following assumptions are adopted. First, there is no discounting by firms or consumers. Second, used units have no scrap value and there is no secondhand market on which to sell used units. Third, following Fudenberg and Tirole (1998), a firm that sells upgrades in the second period is allowed to price discriminate. That is, the firm can charge one price to consumers who are upgrading a used unit of the producer's complementary product and a different price to those who did not previously consume a complementary unit produced by the firm. Fourth, attention is restricted to Pure Strategy Subgame Perfect Nash Equilibria.¹⁴

The timing of the game is as follows. The first period consists of three stages. First, the monopolist chooses whether to have tied or individual products, where following Whinston (1990) it is assumed that ties are irreversible, i.e., if a consumer purchases a tied product from the monopolist then a consumer cannot add a unit of the alternative producer's complementary good to the system.¹⁵ Second, the firms simultaneously choose prices and whether or not to sell

¹⁴ The analysis is also restricted to parameterizations for which $N(\lambda - c_c)/2 > R$. This assumption serves to reduce the number of cases that need to be considered.

or lease, where all prices are restricted to be non-negative. Third, consumers simultaneously choose which products to purchase and lease. The second period then consists of the following three stages. First, the firms simultaneously choose whether to invest R and upgrade their complementary products. Second, the firms simultaneously choose prices for their products. Third, consumers simultaneously choose which products to purchase and lease.

B) Analysis

As in the analysis of the previous model, I will start with the benchmark analysis of what happens in the absence of consumer switching costs, i.e., $\Delta=0$. In this case the monopolist can never increase its profits by tying, where the basic logic of the argument is the same as the logic in Whinston's (1990) classic analysis. Suppose initially that there are no consumer switching costs and that there is no alternative producer. One optimal behavior for the monopolist in this case is to tie and lease in the first period, invest R at the beginning of the second period, and then tie and lease upgraded systems in the second period. Let P_1^T denote the optimal price in this strategy for a basic system in the first period and P_2^T denote the optimal price in this strategy for an upgraded system in the second period.

But notice that there is an alternative leasing strategy that does not involve tying but that does just as well in this case (in fact, there are many alternative strategies that do just as well in this case including strategies in which the monopolist sells rather than leases its products). That is, suppose the monopolist does not tie, invests R at the beginning of the second period, and in each period t leases the primary product for $P_t^T - c_C$ and the relevant complementary product for c_C . Since individuals are only interested in consuming systems, this alternative strategy will result in the same consumption levels for the consumers, the same aggregate prices being paid by the consumers, and the same overall profitability for the monopolist. Call this profit level π^T .

¹⁵ If the monopolist ties in the first period and upgrades in the second, it is possible to add the monopolist's upgraded complementary product to its systems in the second period.

Now consider what happens when there is an alternative producer. Suppose first that the monopolist ties. Because ties are irreversible and the monopolist's primary good is essential, when the monopolist chooses this behavior the situation is equivalent to there not being an alternative producer. From earlier, therefore, we know that an optimal strategy in this case is that the monopolist leases, invests R at the beginning of the second period, and charges P_1^T for the tied product in the first period and P_2^T for its upgraded tied product in the second period. The monopolist's overall profitability for this strategy is π^T .

Now suppose the monopolist does not tie and chooses the same behavior as the alternative behavior given above. That is, the monopolist does not tie, invests R at the beginning of the second period, and in each period t leases the primary product for $P_t^T - c_C$ and the relevant complementary product for c_C . Because the monopolist's primary product is essential, whatever the alternative producer chooses to do, this strategy must result in consumers leasing the monopolist's primary product in each period. Further, since the complementary product is being leased at cost, whether or not the monopolist leases complementary units it earns π^T . In turn, given that this strategy guarantees the monopolist π^T independent of what the alternative producer chooses to do, the monopolist's equilibrium profitability when it chooses not to tie cannot be below π^T . In other words, tying does not improve monopoly profitability in this case.

In summary, in the absence of consumer switching costs and given leasing is an option, this model is consistent with Whinston's (1990) argument that tying is never used for exclusionary reasons when the monopolist's primary good is essential, where the logic behind the result is the same as in Whinston's analysis. By leasing the products individually and setting the price of the complementary good in each period at the complementary good's marginal cost, the monopolist can ensure itself profits at least as high as with tying and so tying is not needed to eliminate competition from the alternative producer. I will now show that this result does not hold when switching costs are present.¹⁶

¹⁶ Carlton and Waldman (2005a) show that, if firms can sell but cannot lease their products, then tying can be profitable for the monopolist in this model even if consumer switching costs are not present.

Suppose consumer switching costs are positive, i.e., $\Delta > 0$, and the monopolist ties. In this case monopoly profitability is independent of whether it leases or sells its products. For example, suppose the monopolist leases. Then in the first period it will charge V_M for its basic tied product, while in the second period it will invest R and then charge $V_M + \Delta + \lambda$ for its upgraded tied product. Its overall profitability is then given by $N[V_M - c_P - c_C] + N[V_M + \Delta + \lambda - c_C] - R$. Note that the profitability here is the same as in the case of tying and leasing in the absence of switching costs except now there is an extra term in the expression for second-period profits that reflects added second-period profits due to consumer switching costs.

In the absence of consumer switching costs there was a simple pricing strategy associated with leasing individual products that ensured the monopolist overall profits at least as high as with tying. This is no longer the case because a consumer's valuation in the second period for a system consisting of the monopolist's primary product and upgraded complementary product depends on first-period consumption decisions. In particular, if individuals consume the alternative producer's complementary product in the first period, then there is a decrease in the valuation consumers place in the second period on a system consisting of the monopolist's primary product and upgraded complementary product. This is why the monopolist cannot always ensure itself tying profits by leasing individual products and employing the pricing strategy discussed in the benchmark case.

To see the problem more precisely, suppose that in the first period consumers lease the monopolist's primary product and the alternative producer's complementary product. If Δ is sufficiently large, then in the second period both firms invest, consumers lease the monopolist's primary product at a price of $V_M + \lambda - c_C + [(V_A - V_M + \Delta)/2]$, and consumers lease the alternative producer's upgraded complementary product at a price of $c_C + [(V_A - V_M + \Delta)/2]$. Note that these prices follow from our assumption that the second-period surplus associated with the alternative producer's upgraded complementary product is divided equally between the two firms. Also, the monopolist chooses to upgrade even though it does not sell complementary units in the second

period because upgrading allows the firm to raise the lease price for its primary product and in this way capture all of λ rather than half of it.¹⁷

Now consider pricing in the first period. Since the alternative producer's first-period price cannot be negative, the monopolist cannot lease its primary product for more than V_A . Thus, if consumers lease the monopolist's primary product and the alternative producer's complementary product in the first period and Δ is large, then there is an upper bound on overall monopoly profits equal to $N[V_A - c_P] + N[V_M + \lambda - c_C + (V_A - V_M + \Delta)/2] - R$. Comparing this expression with monopoly profits given tying yields that, if Δ is sufficiently large, then tying profits are larger. That is, by tying the monopolist gives up the opportunity to capture any profits associated with the fact that the alternative producer's complementary product is superior, but captures all of the profits rather than half of the profits due to the switching costs. If Δ is sufficiently large, then capturing all of the profits due to the switching costs is more valuable.

The above logic leads us to the main result of the analysis of this model which is that, even though the monopolist's primary good is essential for all uses of the complementary good in each period, if Δ and λ are both sufficiently large then the monopolist maximizes its profits by tying. As discussed above, by tying the monopolist captures all of the profits due to the switching costs while leasing individual products allows the monopolist to only capture some of those profits. Hence, if Δ is sufficiently large, then tying profits are higher than the profits associated with leasing individual products.

Note that the above argument explains why tying is preferred to leasing individual products. It does not address whether the monopolist prefers tying to selling individual products. This is where the condition that λ must also be large to ensure that tying is profitable becomes important. One can show that if the monopolist sells rather than leases individual products, then it is possible that the monopolist will be able to capture much of the potential profits due to the second-period switching costs. But it is also the case that when the monopolist sells rather than

¹⁷ Our earlier assumption that $N(\lambda - c_C)/2 > R$ (see footnote 14) ensures that upgrading by the monopolist to capture all of λ is profitable.

leases individual products, the firm is unable to capture all of the profits due to the upgrade value, λ .¹⁸ Hence, since leasing individual products means the monopolist is unable to capture all of the potential profits due to Δ while selling individual products means the firm is unable to capture all of the potential profits due to λ , when Δ and λ are both sufficiently large the monopolist ties.

An interesting aspect of this result is that, although tying is sometimes used by the monopolist to extend its market power to the tied-good market, the social-welfare implications of prohibiting tying in this case are ambiguous. Consider a parameterization in which if tying is allowed the monopolist ties in order to monopolize the complementary-good market. If tying were prohibited, there are two potential effects on social welfare. On the one hand, eliminating tying would increase social welfare because individuals would consume the alternative producer's superior complementary product rather than the monopolist's inferior product. On the other hand, since in the absence of tying both firms sometimes invest in R&D while with tying only the monopolist invests, eliminating tying can reduce the aggregate expenditure on R&D. When only the first effect is present prohibiting tying necessarily increases social welfare, but when both effects are present it is possible that prohibiting tying actually lowers social welfare.

In summary, this section has considered a durable-goods monopoly model in which there is a complementary good that can be produced both by the monopolist and an alternative producer, where the monopolist's primary good is essential for all uses of the complementary good. The main result is that the introduction of consumer switching costs expands the circumstances in which the monopolist ties the complementary good in order to extend its monopoly power to the complementary-good market. Specifically, consistent with Whinston's (1990) classic analysis, in the absence of switching costs the monopolist cannot increase its

¹⁸ The logic behind this result is discussed in detail in Carlton and Waldman (2005a). The basic idea is that most of the profits due to the upgrade value are captured in the second period and, if the monopolist sells individual products, then it frequently sells nothing in the second period which means it captures little of the profits due to the upgrade.

profits by tying because of the assumption that the monopolist's primary good is essential for all uses of the complementary good. However, even given this assumption, when switching costs are positive tying is sometimes employed because it extends the firm's monopoly power to the complementary-good market.

IV. ANTITRUST POLICY

In the previous two sections I analyzed how the introduction of consumer switching costs has important effects on how behaviors of recent interest in antitrust circles affect social welfare. In this section I discuss what these results imply for optimal antitrust policy. The first subsection discusses aftermarket behavior, where most of the focus is on settings in which there is competition in the new-unit market. The second subsection discusses tying behavior by firms with significant market power.¹⁹

A) Aftermarket Monopolization

Consider first the case in which a competitive durable-goods producer monopolizes an aftermarket associated with its own durable product. Based on the analysis in Section II it is clear that, if there are consumer switching costs and purchasing the aftermarket product is a substitute for replacing used units as is true in the case of maintenance, then aftermarket monopolization should be allowed. Because of the switching costs, in the absence of monopolization consumers will inefficiently substitute the aftermarket product for the replacement of used units. Hence, in this case aftermarket monopolization will frequently improve both social welfare and consumer welfare because the firm will have an incentive to price the two products in a manner that reduces the inefficient substitution.

Now suppose there are no consumer switching costs and/or consumption of the aftermarket product is not a substitute for the replacement of used units. Then, consistent with arguments in papers such as Borenstein, Mackie-Mason, and Netz (1995), there is a stronger

¹⁹ For a more extensive discussion of the views presented here see Carlton and Waldman (2005b,2005c).

case for intervention. The basic argument is that aftermarket monopolization in such a setting frequently results in a deadweight loss due to the monopoly pricing of the aftermarket product (interestingly, however, this result was not found in the analysis of Section II). Hence, since prohibiting aftermarket monopolization eliminates this inefficiency, such intervention is justified in the absence of consumer switching costs.²⁰

One drawback of the above discussion concerning the optimal policy when there are no consumer switching costs concerns how aftermarket monopolization is actually achieved in many real-world cases. That is, in many cases the firm achieves aftermarket monopolization by refusing to sell spare parts to alternative providers of the aftermarket service. This is problematic because, if the government were to prohibit aftermarket monopolization in such a case, the firm could simply respond by raising the spare-part price and in this way achieve a result similar to that which it achieves through aftermarket monopolization. Hence, unless the government also regulates the price of spare parts which seems to be a task beyond what one would typically think would be feasible for antitrust authorities, prohibiting aftermarket monopolization in the absence of consumer switching costs would likely result in little improvement from a social-welfare standpoint.²¹

I now briefly turn to antitrust policy concerning aftermarket monopolization when the firm has market power in the market for new durable units. In this case there are potentially two countervailing effects associated with the practice of aftermarket monopolization, where the argument that follows is similar to the argument in Malella and Nahata (1980) concerning complementary goods that are used in variable proportions. On the one hand, if the aftermarket

²⁰ It is sometimes also argued that there is an additional reason for intervention in the case in which the aftermarket monopolization is not anticipated by consumers, i.e., the surprise associated with the monopolization causes a transfer between consumers and the firm which lowers consumer welfare although not social welfare. However, if there is indeed competition in the initial market for new durable units, the validity of this argument is not clear cut since any transfer of this sort should be reflected in a lower initial price for new durable units.

²¹ In fact, from a theoretical standpoint prohibiting monopolization in this case without regulating the price of spare parts could in fact reduce social welfare. The reason is that the increased price for spare parts could cause inefficient substitution of service for spare parts in the production of the aftermarket product.

product and the replacement of used durable units are substitutes, then, similar to the argument of Section II, aftermarket monopolization can increase social welfare by reducing inefficient substitution of the aftermarket product for the replacement of used durable units.²² On the other hand, aftermarket monopolization can serve to decrease social welfare by increasing the firm's market power in the market for new durable units and thus increasing the deadweight loss due to the above marginal cost pricing of those units.

Given the ambiguous effect on social welfare that aftermarket monopolization has in this type of setting, my sense is that the antitrust authorities in such a case should lean towards allowing the behavior rather than prohibiting it. There are three reasons behind this conclusion. First, since the social-welfare effect is ambiguous, it is quite possible that prohibiting aftermarket monopolization will reduce rather than increase social welfare. Second, as before, effectively prohibiting aftermarket monopolization will frequently require the government regulating the price of spare parts and this does not seem particularly feasible. Third, aftermarket monopolization is a type of tying behavior and we know that tying is pervasive in the real world and is frequently driven by efficiency considerations.²³ Hence, to the extent the courts have difficulty judging motivation, prohibiting aftermarket monopolization will lower welfare when the courts conclude that the motivation for the behavior is one of the factors discussed above when, in fact, the behavior is being driven by other efficiency concerns.

In summary, prohibiting aftermarket monopolization is not justified when there is competition in the market for new durable units and consumer switching costs. The reason is that in this case aftermarket monopolization frequently serves to increase social welfare by avoiding a distortion concerning the frequency with which used units are replaced, so prohibiting aftermarket monopolization will frequently reduce rather than increase social welfare. In

²² See Tirole (1988) for a reader exercise along this line.

²³ See Carlton and Perloff (2005) and Evans and Salinger (2005) for discussions of efficiency rationales for tying.

contrast, there is a stronger case for prohibiting aftermarket monopolization when either consumer switching costs are absent and/or the firm has market power in the market for new durable units. But even in these cases prohibiting aftermarket monopolization is problematic because of both the difficulty antitrust authorities would have in regulating the price of spare parts and the difficulty courts have in judging motivation in combination with the many efficiency rationales associated with tying.

B) Monopoly Tying of Complementary Products

In this subsection I consider optimal antitrust policy for the case of a monopolist that ties a complementary product to the monopolist's primary product. The first issue to consider for this problem is one of the same issues discussed in the previous subsection. Tying in the real world is pervasive and most tying in the real world is driven by efficiency considerations. Combine this with the difficulty that courts have in identifying motivations behind tying and one reaches the conclusion that an aggressive policy of intervention can easily result in a reduction rather than an increase in social welfare. Hence, my overall view is that intervention should only occur when there is clear evidence of a socially harmful rationale for tying and there is no plausible efficiency rationale for the behavior.

The literature describes three distinct settings in which tying is used to extend market power to a complementary-good market with the likely or at least possible result being a decrease in social welfare. The first such setting was initially discussed in Whinston's (1990) classic analysis of tying. Consider a setting in which the complementary good has two uses, where in one the primary and complementary goods are used in combination while, in the other, use of the complementary good does not require the primary good. If, for example, there are economies of scale in the production of the complementary good, then the monopolist may tie the complementary good to the monopolized primary good because tying induces exit in the complementary-good market. This can increase monopoly profitability because the reduced

competition in the complementary-good market allows the monopolist to increase its profits when selling complementary units for the use that does not require the primary good.

The second setting in which tying is used to extend market power with a resulting decrease in social welfare is the setting explored in Carlton and Waldman (2002). The basic argument in that paper is that tying of a complementary product can be used to preserve a monopoly position in the market for the monopolist's primary good and this reduction in competition lowers social welfare. Consider a two-period model with a monopolist who can produce primary and complementary goods in each period while the alternative producer can enter the complementary market in the first period and the primary market in the second. Further, assume that the two firms produce primary products of equal quality but the alternative producer's complementary product is superior to the monopolist's. Finally, assume that the alternative producer has entry costs for both the primary and complementary markets and individuals only consume systems, where a system consists of one primary unit and one complementary unit.²⁴

In this setting the monopolist may tie in the first period to stop the alternative producer from entering the primary market in the second period and in this way preserve its monopoly position in the primary market in the second period. The argument is as follows. In this model the alternative producer enters the primary market in the second period because it allows the firm to capture more of the surplus associated with its superior complementary product. By tying the monopolist stops the alternative producer from capturing any surplus in the first period from its superior complementary product and this can cause the alternative producer never to enter the complementary market because it is not able to cover its complementary-market entry costs. In turn, given that the return to entering the primary market is that it captures more of the surplus associated with its superior complementary product, if it never enters the complementary market then it also does not enter the primary market in the second period. Note further that when the

²⁴ Carlton and Waldman (2002) also show similar results when there are no entry costs for the complementary good, but instead there are complementary-product network externalities.

monopolist ties for this reason the result is a decrease in social welfare because in the second period the primary market is transformed from a competitive outcome to monopoly.

The third setting in which tying may be used to extend market power in a manner that reduces social welfare is the setting discussed in Section III. The basic argument there is that, given consumer switching costs for the complementary product, tying may be used to eliminate competition in the complementary market because this allows the firm to capture all of the profits due to the switching costs.²⁵ In that two-period analysis the monopolist is the sole producer of the primary good in each period, while both firms can produce the complementary product in each period. Further, as in the previous discussion, the alternative producer's complementary product is superior.

As discussed in Section III, the basic argument is that, if the monopolist does not tie and individuals consume the alternative producer's complementary product in the second period, the monopolist may not be able to capture all of the profits due to the switching costs because in the second period the switching-cost value will be associated with the alternative producer's upgraded complementary product. By tying the monopolist forces individuals to consume the monopolist's complementary product in the first period and this can increase monopoly profitability because the monopolist now captures all the potential profits due to the switching costs. Further, this tying necessarily lowers social welfare as long as the research and development cost associated with upgrading complementary products in the second period is not too high.

In summary, in the real world tying is pervasive and is frequently driven by efficiency considerations. As a result, the antitrust authorities should only intervene concerning the tying of complementary products by a monopolist (or firm with significant market power) when the evidence clearly points to a tying rationale that lowers welfare and there is no plausible efficiency rationale for the behavior. My understanding of the literature is that there are three

²⁵ As mentioned earlier in footnote 16, Carlton and Waldman (2005a) show that this result extends to a setting that lacks consumer switching costs if firms can only sell rather than lease their products.

settings in which the tying of complementary products by a monopolist may be used with the likely result being lower social welfare: i) tying is used to monopolize a use of the complementary good that does not require the monopolist's primary good; ii) tying is used to preserve the monopolist's market power in the primary market; and iii) tying is used to eliminate competition in the complementary-good market and in this way capture profits due to complementary-market switching costs.

V. CONCLUSION

The key question in much of antitrust economics is under what circumstances will specific firm behaviors lower social welfare and/or consumer welfare for reasons linked to monopolization and thus be a potential target for antitrust intervention. Most of the classic analyses that address this question do not incorporate consumer switching costs, but this is an important omission. The ex post market power that switching costs create can have important implications for whether or not specific behaviors serve to either increase or decrease social welfare. Further, for various reasons such as learning-by-doing and the transactions costs of finding new suppliers, consumer switching costs are common in real-world environments. Thus, it is important that antitrust authorities have a clear understanding of how the presence of consumer switching costs affects the conclusions of analyses of real-world behaviors of interest.

In this paper I illustrated the above argument by discussing the importance of consumer switching costs for understanding the social-welfare implications of two behaviors that have drawn significant recent interest in antitrust circles. The first is the behavior that was at the heart of the 1992 Kodak case in the US, i.e., a firm with no market power in the market for new durable units monopolizes an aftermarket, such as the market for maintenance, associated with its own durable units. The analysis discussed in Section II shows that whether such behavior deserves antitrust scrutiny depends in an important way on whether consumer switching costs are present. Specifically, in the presence of switching costs monopolizing the aftermarket typically increases social welfare because it eliminates a distortion concerning whether

consumers replace their used units. So when switching costs are present antitrust scrutiny is typically not warranted. Notice that this is an important result because in many of the important real-world cases such as the Kodak case the evidence points to a significant role for consumer switching costs.

The second behavior I used to illustrate the importance of consumer switching costs for antitrust analysis is that of a monopolist that ties a complementary good to his monopolized primary good. This is a topic of long-standing interest in the antitrust literature, where interest in this topic is currently particularly high because of Microsoft's behavior in the marketing of Windows. The analysis discussed in Section III shows that the presence of switching costs increases the set of circumstances in which a monopolist ties in order to extend its monopoly power to the tied-good market. Previous literature shows that, if a monopolist's primary good is essential for all uses of a complementary good, then tying will not be used by the monopolist to extend its monopoly power to the complementary-good market. This suggests that, if the monopolist's primary good is indeed essential, then tying behavior should not be subject to antitrust scrutiny. But the analysis discussed in Section III shows this is not correct in a world characterized by complementary-good switching costs. In that analysis, even when the primary good is essential, if switching costs are sufficiently large the monopolist may tie in order to monopolize the complementary-good market. Hence, in the presence of consumer switching costs, tying by a monopolist may justify antitrust scrutiny even when the monopolist's primary good is essential.

From the standpoint of future research, the obvious exercise suggested by this paper is to consider how the introduction of consumer switching costs affects the analysis of other related issues of interest. For example, one issue that might be worth investigating is that of merger policy. The standard approach concerning merger policy is to consider intervention for horizontal mergers that increase market power significantly, but at least in the US other types of mergers are typically not considered a problem from an antitrust perspective. However, given the results of Section III concerning the broader set of circumstances in which tying may be used

to extend monopoly power when switching costs are present, it is possible that further investigation of merger policy given switching costs might suggest intervention is sometimes worthwhile for mergers concerning complementary-good producers. This suggestion is speculative at this point, but further investigation of the issue does seem warranted.

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