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A NEW PERSPECTIVE ON PLANNED OBSOLESCENCE*

MICHAEL WALDMAN

I. INTRODUCTION

Automobile manufacturers have long had a policy of introducing annual style changes into their new model cars. Textbook publishers have a policy of periodically bringing out revised editions of their popular books. Recently, IBM changed the operating system used in its personal computers causing a reduction in the compatibility between its old and new machines. If one were to ask the typical man in the street to explain what is happening in these markets, he would not hesitate before giving the following answer. In economists' terminology, he would say that for the above firms the incentive to introduce new products that make old units obsolete is "too high"; i.e., the firms have an incentive to practice planned obsolescence.

Of course, just as is true for the man in the street, economists have also long observed and commented on the speed with which new products are introduced. For example, Galbraith [1958] suggests that the annual model changes of automobile manufacturers are socially wasteful, while Fisher, Griliches, and Kaysen [1962] provide empirical estimates of the costs of these changes. There have also been numerous theoretical attempts to model the idea of planned obsolescence (or the related idea of killing off the market for secondhand goods), but most of these models have in fact considered the choice a monopolist faces concerning how much durability to build initially into his product, rather than the monopolist's incentive to introduce new versions of his product over time.¹ In this paper I consider planned obsolescence from the standpoint of a firm that can change the nature of what it sells, and show that the man in the street is in fact correct. In many settings the incentive for a durable goods monopolist to introduce new products that make old units obsolete will be above that which is socially optimal.

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1. See, for example, Swan [1972], Bulow [1986], Rust [1986], and recent discussions in Tirole [1988] and Carlton and Perloff [1990].

The basic logic behind the above conclusion is that a firm in such a setting faces a time-inconsistency problem. Consider a monopolist of a durable good who sells output in each of two periods. In the second period the seller will not internalize how his current behavior affects the value of units previously sold. Building on the earlier work of Coase [1972], Bulow [1982] used this logic to show that in such a setting the monopolist will sell "too much" in the second period. That is, the firm's second-period output will be higher than if he marketed his output through renting, with the subsequent result being that profits are lower than under the rental solution. The point of the current paper is that a similar problem arises in the case of new product introductions. The logic is that because the monopolist does not internalize in the second period how his behavior affects the value of units previously sold, in many settings his incentive to introduce new products that make old units obsolete will be too high. For example, automobile producers may face a socially nonoptimal incentive to introduce style changes that lower the value of old cars, while textbook publishers may face a similar nonoptimal incentive to introduce new editions that "kill off" the market for previous editions of their popular books.²

Despite many similarities, there is an important difference between this paper's argument and that put forth by Coase and Bulow. In the Coase-Bulow argument the time-inconsistency problem causes the monopolist who sells his output to behave in a fashion such that profits are lower than in the rental solution, but social welfare is in fact higher. In contrast, in the settings considered here the monopolist who sells his output behaves in a manner such that both profits *and* social welfare are lower than in the rental solution. Hence, although the Coase-Bulow argument and the argument of this paper share a common theme, the implications for social welfare are quite different.

Before proceeding to the analysis, it is worth briefly discussing the differences between the type of planned obsolescence found in the current paper, and that found by Bulow in his 1986 paper. What Bulow shows is that to overcome the above discussed incentive for the monopolist to sell too much in the second period, the firm may build a level of durability into its output that is below the socially optimal amount. Thus, an obvious difference is that

2. Obviously, the argument of this paper is only applicable to the automobile case to the extent that it is valid for oligopoly behavior. In Waldman [1989] I provide a brief discussion of the oligopoly case.

Bulow's planned obsolescence is not of the form found in this paper which concerns the monopolist's incentive to introduce new products too frequently. There is, in addition, a second and in some sense more fundamental difference. In Bulow's analysis planned obsolescence is used by the firm to avoid a problem due to time inconsistency, while here planned obsolescence is the direct result of time inconsistency. In other words, in Bulow's analysis planned obsolescence is the cure, while here it is the illness itself.

II. NETWORK EXTERNALITIES AND PLANNED OBSOLESCENCE

Katz and Shapiro [1986] consider a two-period model characterized by network externalities where two competing and incompatible technologies are each available in both periods. They investigate which technology is adopted under a variety of assumptions concerning the specification of property rights. In this section I demonstrate the argument put forth in the Introduction by investigating a variant of the Katz and Shapiro model which is characterized by a single monopoly producer.³

A. The Model

The model that follows is kept as simple as possible so that we can easily focus on why planned obsolescence arises. As indicated, there is a single monopoly producer in a market that lasts two periods. In the first period the producer only has access to technology *A*, where technology *A* is characterized by a constant marginal cost of production *c*, no fixed costs, and output that is perfectly durable. In the second period the firm gains access to a competing and incompatible technology, call it technology *B*, which similarly has a constant marginal cost *c* and no fixed costs.

The demand side of the model is as follows. There are *N* identical individuals in group 1 who are present in the market in both periods. In each period a group 1 individual consumes (makes use of) either zero units or one unit of the monopolist's output. The total benefit an individual derives from a unit of output in a particular period depends positively on the total number of compatible units consumed in that period; i.e., there are positive network externalities. To be specific, if in period *j*, *j* = 1,2, a group 1 individual consumes a unit of technology *k*, *k* = *A,B*, then he

3. Other papers concerned with the topic of network externalities include David [1985], Katz and Shapiro [1985], and Farrell and Saloner [1986].

receives a gross benefit equal to $V_k + N_k^j$, $V_A + 1 > c$, where N_k^j is the total number of individuals who use technology k in period j . The assumption $V_A + 1 > c$ guarantees that individuals in group 1 consume in the first period. It is also assumed that there is no discounting. Hence, the lifetime net benefit derived by a group 1 consumer is equal to the sum of his first- and second-period gross benefits minus his expenditure in purchasing or renting output from the monopolist.

There are also N individuals in group 2, where group 2 is identical to group 1 except that group 2 individuals are only present in the market in the second period. In that period the monopolist might want to offer a lower price for technology B to those individuals who previously purchased a unit of technology A . This arises when he sells his output and the strategy that maximizes second-period profits is to sell technology B to both groups. In this case it is assumed that the firm can offer a lower price to those consumers able to trade in a unit of technology A when they purchase a new unit.

There are three final points. First, for some choices of prices by the firm in each of periods 1 and 2, there are multiple equilibria for the subgame that starts with consumer purchase decisions. Similar to the approach taken by Katz and Shapiro, I assume that purchase decisions are made as if consumers could coordinate behavior. That is, if there are multiple equilibria for a subgame that starts with consumer purchase decisions, then the equilibrium realized is the one that is Pareto optimal for the consumers purchasing during that period. Another way to put the assumption is that I restrict attention to Perfectly Coalition-Proof Nash equilibria.⁴ Second, given the specification of the model, each individual always consumes a unit of the monopolist's output every period he is in the market. Hence, whether social welfare is maximized simply depends on what is consumed in the second period and not how much is consumed. Third, this is a full information model.

B. Analysis

The point of the analysis is to show that if the monopolist sells his output, then both from the firm's private standpoint and from a social welfare standpoint, his incentive will be too high to switch to

4. See Bernheim, Peleg, and Whinston [1987] for a discussion of this refinement.

technology B in the second period. The reason is that when he chooses which type of output to sell in the second period, he does not internalize how his choice affects the value of the units he sold in the previous period. Or to put the result another way, the monopolist faces a time-inconsistency problem; i.e., his actual technology choice in the second period is sometimes different from the choice he would make if he could commit to his second-period technology in the first period.

Waldman [1989] provides a formal analysis that characterizes the unique Perfectly Coalition-Proof Nash equilibrium for this model. Here I provide a less formal analysis that highlights the main results. We begin by considering a benchmark with which later results can be compared. Assume that the monopolist sells his output *and* has the ability to commit to his second-period technology in the first period. Because the monopolist in the second period can charge a lower price to those individuals who trade in an old unit, the firm has the ability to perfectly price discriminate. Hence, to determine the monopolist's decision under commitment, we must compare social surplus in three cases:

(a) *No switch*. By employing technology A in both periods, total surplus is $(V_A + N - c)N$ in period 1 and $(V_A + 2N)N + (V_A + 2N - c)N$ in period 2, for a total of $(3V_A + 5N - 2c)N$.

(b) *Switch, group 1 consumers buy twice*. Here the monopolist switches to B and sets the price for consumers offering a trade-in low enough that all group 1 consumers purchase a unit of B in the second period. Total surplus for period 1 is still $(V_A + N - c)N$. In period 2 we now have $(V_B + 2N - c)2N$, for a total of $(V_A + 2V_B + 5N - 3c)N$.

(c) *Switch, group 1 consumers remain with A*. Here the monopolist switches to B but does not sell any new units to group 1 consumers. First-period surplus is again $(V_A + N - c)N$, while surplus in the second period is $(V_A + N)N + (V_B + N - c)N$. The total is $(2V_A + V_B + 3N - 2c)N$.

For the monopolist in the commitment case to choose not to switch—or equivalently, for not switching to be socially efficient—we need (a) $>$ (b) and (a) $>$ (c). That is, we require (1) and (2) to hold:

$$(1) \quad V_A > V_B - c/2$$

$$(2) \quad V_A > V_B - 2N.$$

Let us now consider what happens when the monopolist *cannot* commit to his second-period technology in the first period. In this case when period 2 arrives, the firm must decide whether to switch to technology *B*, given whatever money has already been collected in the first period. There are three cases. The first case is that the monopolist stays with technology *A*. The second-period profits associated with this case equal $(V_A + 2N - c)N$. A second case is that the monopolist switches to technology *B*, and as a result group 1 consumers purchase a new unit from the monopolist in the second period. For this case the second-period profits associated with selling to group 1 equal $(V_B - V_A + N - c)N$, while the second-period profits associated with selling to group 2 equal $(V_B + 2N - c)N$.⁵ The last case is that the monopolist switches to technology *B*, but group 1 consumers do not purchase a new unit in the second period. For this case second-period profits equal $(V_B + N - c)N$. A comparison of the first two cases yields that the monopolist switches to technology *B* if (3) holds, while a comparison of the first and third cases indicates that the monopolist switches if (4) holds:⁶

$$(3) \quad V_A < V_B + (N - c)/2$$

$$(4) \quad V_A < V_B - N.$$

We now have that having the firm remain with technology *A* is socially efficient if (1) and (2) hold, while in the no-commitment case the monopolist switches to *B* if either (3) or (4) holds. A comparison of (1) and (2) with (3) and (4) yields that, in the absence of the ability to commit, there are parameterizations where the monopolist switches even though it is socially efficient for him to remain with technology *A*. This inefficiency can take either of two forms. First, in what might be called weak planned obsolescence, social welfare is maximized if everyone consumes *A* in the second period, but the no-commitment solution is characterized by group 2 purchasing and consuming *B* in the second period while only group 1 consumes *A*. Second, in what might be called strong planned obsolescence, social welfare is again maximized if everyone consumes *A* in the second period, but the no-commitment solution

5. In the unique Perfectly Coalition-Proof Nash equilibrium, the price charged a group 1 individual is $V_B - V_A + N$. This is the amount extra achieved by a group 1 agent relative to the benefit he would receive if all group 1 agents remained with technology *A*.

6. If both (3) and (4) hold, then group 1 switches if $V_A < V_B + 2N - c$.

is characterized by both groups purchasing B and consuming B in the second period.

A stark illustration of the misincentives the monopolist faces is captured by the following example. Suppose that $c = 0$ and $V_A - N/2 < V_B < V_A$. In this example the technology that the monopolist gains access to in the second period is strictly inferior to the original technology. Yet, in the absence of an ability to commit, the monopolist switches to the inferior technology when he gains access to it. By doing so, he causes group 1 individuals to buy new units from him, and from the standpoint of *second-period* profits, this more than offsets the fact that he is selling a strictly inferior product.

I would like to end the section with two points. First, consistent with the Coase and Bulow analyses, the time-inconsistency problem does not arise if the monopolist rents rather than sells his output (this is demonstrated in Waldman [1989]). The logic for this result is simple. The time-inconsistency problem arises above because the monopolist does not internalize how his second-period behavior affects the value of units he previously sold. In the rental case he retains ownership of those units, and thus in the second period in the rental case he would internalize how his behavior affects the value of those units. Second, I would like to emphasize that social welfare is not all that is sacrificed in the no-commitment case above. When the monopolist behaves in the socially incorrect manner, he also lowers his own profitability. The logic for why he faces a private misincentive is identical to that in the Coase-Bulow analysis. Because he does not internalize in the second period how his behavior affects the value of previously sold units, his private incentive to behave in a manner which lowers that value is too high. In other words, since the second-period value of the previously sold units affects the price he initially receives for those units, the nonoptimal incentive he faces in the second period serves to lower his own profits as well as social welfare.

III. DISCUSSION

In the previous section I demonstrated that planned obsolescence can arise in an environment characterized by network externalities. In this section I discuss how the argument of the paper applies to the case of the textbook publisher and to that of

the firm which introduces style changes. I then discuss the antitrust implications of the argument.⁷

A. The Textbook Publisher

Consider the publisher of a popular textbook who periodically introduces new editions of his book. This firm is in a situation similar to that of the monopolist considered in the previous section. To see why, consider the following. From our standpoint, there are two important decisions faced by this firm. First, the firm must decide how often to introduce new editions, where the introduction of a new edition results in a discrete drop in the value of old copies. Second, in revising the book he must decide how similar to make the new edition to the current edition. What is important here is that a more dramatic change will make it more difficult for a student to continue to use an old copy, and hence, will have a bigger negative effect on the value of old copies.

Another way of putting the above is that, every period in which the firm sells copies of his book he must decide how compatible to make new copies with old copies, and his choice concerning compatibility affects the value of copies he previously sold. That is, as already stated, this firm is in a setting similar to that considered in Section II. That analysis thus suggests that, both from his own private standpoint and from a social welfare standpoint, this firm's incentive to make new copies incompatible with old copies will be too high. In other words, the firm will have an incentive to bring out new editions "too soon," and when he brings out a new edition, he will have an incentive to write it in such a way as to "kill off" the market for old copies.

B. Style Changes

Consider a monopolist who can change the style—say the appearance—of what he sells. In some circumstances, such a firm will have an overly high incentive to introduce style changes into its new units of output. The logic follows. Suppose that consumers place a lower value on old units when old and new units differ in terms of their appearance. A firm faced with customers of this sort will face the same time-inconsistency problem analyzed in the model of Section II. Again, because the firm does not internalize how its behavior affects the value placed on old units, its incentive

7. In Waldman [1989] I also demonstrate the argument in a model where consumers care about relative quality, and the monopolist can affect the quality of what he sells through investments in research and development.

will be too high to behave in a manner that lowers this value. What this means in the current setting is that, both from its own private standpoint and from a social welfare standpoint, the firm's incentive to introduce style changes will be too high.

One might object that I am missing an important part of the story. In a setting where consumers place a lower value on old units when old and new units differ in appearance, it will also typically be true that consumers place a higher value on new units that have a distinctive style. Incorporating this aspect of the story into the argument, however, has no effect on the final conclusion. The reason is that the positive effect that a style change has on the valuation of new units will be internalized by the monopolist, while the negative effect on the value of old units will not be internalized. Hence, even if a style change has a positive effect on the value placed on new units, the firm's incentive to introduce style changes will still be too high.

C. Antitrust Implications

The current state of the law is that, for a monopoly seller of a durable good, it is illegal to pursue a policy of solely leasing rather than selling one's output. An important question, however, is whether this prohibition serves to enhance social welfare. A number of authors have used Coase's original analysis to suggest that the rule may indeed be correct. This is, for example, the position taken by Richard Posner: "Professor Coase has argued that the lease-only policy of a monopolist of a durable good, such as United Shoe Machinery Corporation, may be designed to overcome the difficulties encountered in trying to charge a monopoly price for a durable good. Perhaps the lease-only policy should have been forbidden on that ground . . ." [1976, p. 184]. The logic for this position is straightforward. In the Coase-Bulow argument leasing allows the monopolist to move closer to the pure monopoly price, and in Coase's original framework there is no corresponding gain to social welfare that can be attributed to the leasing decision.⁸

Bulow [1982, 1986] has pointed out that the above interpreta-

8. The original antitrust case in which leasing was ruled illegal was a 1953 case concerning the United Shoe Machinery Corporation. It has been argued that, since United employed quite long-term leases, at least for this original case leases were not used to avoid a time-inconsistency problem (see, for example, Wiley, Rasmusen, and Ramseyer [1990]). This argument is not persuasive, however, since United had a policy of releasing a customer from any long-term lease whenever the customer wanted to switch to a newer machine produced by United (see Kaysen [1956]); i.e., in practice it was as if the leases were short term.

tion of Coase's analysis is too narrow. In a Coase-Bulow-type setting, it is true that a prohibition on leasing serves to reduce monopoly power. However, it is also the case that forcing the monopolist to sell may cause inefficiencies in production due to the monopolist's attempt to avoid the time-inconsistency problem. For example, the monopolist might respond by building less than the socially optimal level of durability into his output. The subsequent result is that even though a prohibition on leasing decreases monopoly power, it is still possible for social welfare to be reduced by such a rule.⁹

The analysis of this paper provides a second reason for not accepting Posner's interpretation. A monopolist who leases may be attempting to avoid a time-inconsistency problem concerning new product introductions rather than the time-inconsistency problem considered by Coase and Bulow. This paper shows that prohibiting leasing in such an environment can decrease social welfare even ignoring potential production inefficiencies, and incorporating production inefficiencies would likely only reinforce this result. Hence, if the monopolist leases to avoid a time-inconsistency problem concerning new product introductions, there would seem to be little reason for the government to restrict the manner in which the monopolist can market his output.

IV. CONCLUSION

Does a durable goods monopolist have an incentive to introduce a new product only when it is socially optimal to do so? In this paper I have shown that if such a monopolist markets his output by selling rather than renting, then in many settings his incentive to introduce new products that make old units obsolete will be too high; i.e., he will have an incentive to practice planned obsolescence. The reason is that in deciding whether to introduce a new product and the nature of the new product if introduced, the firm will not internalize how its current behavior affects the value of units previously sold. The subsequent result is that, both from its own private standpoint and from a social welfare standpoint, the firm's incentive to introduce new products that make old units obsolete will in many cases be too high.

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9. See also Bond and Samuelson [1987] and Malueg and Solow [1989].

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