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Technological Tying

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Abstract

This paper explores a firm's incentive to technologically tie when R&D is important and finds that technological tying increases innovation, which is an efficiency not considered in other tying models. Intuitively, technological tying protects the seller from aftermarket entry, ensuring that the seller internalizes the full effect of increased investment in technology on system profits. More importantly, the additional innovation, associated with technological tying, may benefit consumers more than anticompetitive effects hurt them, suggesting that innovation efficiency should be an important consideration in technological tying cases.

[1] The views expressed herein are my own and do not purport to represent the views of the Federal Trade Commission or any Commissioner, or The Brattle Group, Inc. I thank Preston McAfee, Patrick DeGraba, Douglas Rathbun, and Eric Edmondson for helpful comments. Any errors or omissions are the responsibility of the author.

A monopolist engages in technological tying when it designs one product so that it functions only when used in conjunction with its own complementary products. For example, a camera system producer introducing a new camera body that will only work with its own line of lenses has technologically tied its lenses with its camera body. Such a dependency between products may be a necessity of engineering a better product[2] or it may represent the producer's attempt to artificially close the camera system from competition. When a technological tie artificially closes an inherently open system, the tying behavior may be subject to antitrust scrutiny. While claims of technological tying have been before the courts since the early 1970s, little has been said regarding a firm's incentives to technologically tie, the effects of a technological tie on the firm's decision to innovate, and ultimately how consumers are affected by such tying behavior.

This paper addresses each of these issues for a class of tying situations in which the tying firm relies on the tied product market to serve as a metering device. Specifically, a simple two-component system consisting of a foremarket and an aftermarket good is presented. Only owners of the foremarket product consume the aftermarket good. The paper considers the case where the quantity of the aftermarket good can vary as opposed to earlier studies where both products are consumed in fixed proportions. Thus, the model is better suited to an aftermarket good like zip discs and a foremarket good of a zip drive; the number of zip discs can vary. The model assumes that a monopolist produces the foremarket product and that the quality of the system is a function of investment in research and development. Further, it is assumed that all R&D occurs and investments are incurred at the foremarket development stage. In addition to the fixed cost of developing a system of a given quality, there is also an additional fixed cost associated with tying technologically.

The model shows that if the fixed cost of engineering the technological tie is sufficiently small relative to the probability of entry into the aftermarket by a competing firm, the monopolist has an incentive to technologically tie. The tie permits the monopolist to use the tied aftermarket purchases to price discriminate among different

[2] For example, Nikon's 50 and 90 series cameras offer 3D Advanced Matrix Metering with Distance Data Detection only when one of Nikon's own D-type lenses are mounted on the camera body. This dependency on D-type lenses is a technical necessity, however, because the D-type lenses include an "encoder" that relays camera-to-subject distance information from the lens to the camera's microcomputer.

consumer types. The model also finds that investment in system development, and therefore overall system quality, is greatest when the monopolist ties technologically (regardless of whether or not it is optimal for the profit-maximizing monopolist to do so). Finally, the paper shows that social welfare in general and consumer surplus in particular may be improved through technological tying, even in cases where the monopolist would not restrict output of the tying product in the absence of the tie.

While this paper relies on a fictitious camera/lenses system example, the model presented in this paper resembles many high technology systems markets of the real world. One example is the 8-bit Nintendo Entertainment System (NES).

When Nintendo introduced the NES to the U.S. in 1986, the system's hardware component included the 10NES security chip whose only function was to prevent non-Nintendo authorized games from being used with the Nintendo hardware.[3] This security chip was a technological tie that permitted Nintendo to generated additional system revenue through sales of the Nintendo System's software component.

Understanding why a firm may choose to tie technologically and under what circumstances consumers may benefit from such behavior is important to the courts treatment of tying cases in general and to cases of alleged technological tying in particular. This is especially true in light of the district and circuit court rulings in the recent Microsoft trial in which the software giant was accused of technologically tying its browser (Internet Explorer) to the Windows operating system. The finding of liability by the District Court and subsequent remand of the verdict by the Appeals Court is representative of both the court's desire to address issues of technological tying and at the same time, the uncertainty over how to do so.

The courts are faced with a difficult balancing act regarding technological tying claims. On the one hand they are reluctant to become enmeshed "in a technical inquiry into the justifiability of product innovations"[4]. On the other hand, the courts do not want technological tying to become a safe haven for otherwise illegal tying practices.

In the recent District Court case against Microsoft, Judge Penfield Jackson was willing to enter into such a technical inquiry in an attempt to answer the seemingly basic

[3] Atari Games Corp. v. Nintendo of America Inc., 975 F.2d 832

[4] Response of Carolina v. Leasco Response, 537 F.2d 1307, 1330.

It is worth noting that the assumption that all consumers share the same transformation function, $\alpha(\theta)$, restricts the set of possible outcomes and, thus, detracts from the generality of the model. Retuning to our earlier camera/lens discussion, for example, it is possible to imagine a set of consumers who value the camera system only for zoom photography: For this set of customers, as the price of zoom lenses (the add-on product) is increased, beyond their values for the lenses, it is likely that these customers will chose to abandon the camera system altogether rather than consume the basic camera system that lacks zoom capabilities. Under my assumption, and increase in the price of the zoom lens (ceteris paribus) could only cause customers to switch to buying the camera without the zoom lens.

Despite the loss of generality associated with the assumptions on the transformation function, $\alpha(\theta)$ (most notably that all consumers share the same transformation function) the assumptions provide a simple framework that allows for second degree price discrimination to exist in the model and the model remains representative of many modern systems platform markets.

According to this specification, for a given level of technology, s, consumers who have higher valuations for the basic system have more than proportionally higher valuations for the extended system. In this sense, high value users are more constrained by the limitations of the basic system than lower value users.

Producer Behavior:

On the producer side, consider a monopolist who develops the two-component system and assume developing a system is costly, requiring a fixed expenditure for research and development. The research and the associated investment required to develop the technology are incurred at the foremarket development stage. That is to say that the monopolist cannot develop the technology for the foremarket product without also developing the complementary technology of the aftermarket good. Because the basic system and the extended system differ only in the quantity of the aftermarket good, the state of technology incorporated in both systems is the same. Therefore, the fixed

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quantity. See Gaynor (2001), "Non-Exclusionary Bundling of Aftermarket Products" for an explanation of these assumptions. That these assumptions assure that both systems would be offered in the absence of a threat of entry is also shown by Proposition I of the current paper.

aftermarket entry and therefore ensures that the seller internalizes the full effect of increased investment in technology on system profits.

Perhaps even more importantly, this increase in system quality afforded by the technological tie may benefit consumers more than anticompetitive effects hurt them. Therefore, while any analysis of tying policy necessarily involves other efficiency as well as anticompetitive effects, these results suggest that innovation efficiency should be an important consideration in cases involving technological ties.

Given its suggestive nature, this paper raises more questions than it answers. Future research should go beyond showing that the innovation efficiency associated with tying is potentially significant and characterize the conditions in which this effect is most likely to dominate. Despite its suggestive nature, however, an important conclusion from this paper remains: The analysis shows that when evaluating the welfare effects of tying one should consider innovation effects, as such efficiencies can be large enough that consumers benefit from a technological tie.