1-1-2005

# Economic Analysis of Technological Protection Measures

John A. Rothchild
*Wayne State University*

JOHN A. ROTHCHILD*

# Economic Analysis of Technological Protection Measures

The use of technological protection measures (TPMs) by publishers[1] of information goods[2] to prevent unauthorized use of those goods[3] is transforming the very nature of information goods. Implementation of TPMs to protect information goods has been greatly encouraged by the 1998 enactment of the Digital Millennium Copyright Act (DMCA), which added to federal law a set of provisions making it illegal to traffic in technologies that can be used to defeat TPMs and illegal to engage in certain acts that circumvent TPMs. Congress enacted those provisions in response to the entreaties of publishers, who insisted that they would not make their products available in digital formats unless they were provided with effective means of preventing unauthorized appropriations of their products' content. By responding as it did, Congress accepted the proposition that copyrighted works in digital formats are more at risk of infringing uses than are

* Associate Professor, Wayne State University Law School. I gratefully acknowledge the helpful comments received from Stephen Calkins, Michael Carroll, Peter Hammer, Doug Lichtman, Jessica Litman, Peggy Radin, Omri Ben-Shahar, and students in the Cyberlaw and Economics workshop at the University of Michigan Law School. 

[1] I use the term "publisher" to refer to an entity that makes an information good available to the public. The publisher is typically either the owner or a licensee of the copyright to the material contained in the good.

[2] I use the term "information good" to refer to copyright-protected expression that is fixed in some tangible medium. Although TPMs are most commonly applied to information goods stored in digital formats, they may also be used to control access to content stored in analog formats. The scrambling of cable television transmissions is an example of the latter. Several provisions of federal law prohibit the circumvention of TPMs protecting analog information goods. *See* 17 U.S.C. § 1201(k)(1) (2000) (prohibiting manufacture or sale of video cassette recorders that lack prescribed copy control technology); 47 U.S.C. § 553(a) (2000) (prohibiting interception of cable television broadcasts or provision of equipment for this purpose).

[3] For example, a publisher might use a TPM to prevent a music CD from being copied or to disallow a particular copy of a computer program from being installed on more than one computer.

those in analog formats, given the ease with which multiple generations of perfect copies may be made and distributed via digital networks. In theory, TPMs secure copyrighted digital works against infringing uses. In practice, however, any technological protection can be, and usually has been, defeated by the application of sufficient ingenuity. The DMCA's anticircumvention rules are designed to discourage the ingenious from exercising their skills in this particular domain by the threat of civil, and in some circumstances criminal, liability.

While publishers responded to the anticircumvention rules with jubilation, critics focused attention on the rules' less benevolent aspects. The use of TPMs, backed up by the legal sanctions of the anticircumvention rules, has effects that extend well beyond the securing of digital content against infringing uses. These measures also limit or eliminate many uses that the copyright laws otherwise permit, such as fair use, use beyond expiration of the copyright, use of ideas that are unprotected by copyright, sales of copies on the secondary market, lending a copy to a friend, lending by libraries, noncommercial copying of music, nonpublic performance and display, and accessing a work using an unapproved device. Uses whose legal validity is yet unresolved, such as copying for personal archival purposes, are also limited by TPMs. Widespread deployment of these measures could lead to the unattractive prospect of what some call a "pay-per-use" society, in which every access, use, or transfer of an information good lies within the publisher's control and requires payment of a fee.

But the fact that technology-plus-law *permits* such a state of affairs to develop does not necessarily mean that it *will* develop. Publishers are not required to deploy TPMs; they do so as a means of promoting their economic interests. Like all economic actors, publishers are subject to the discipline of the market. A seller cannot sell goods that buyers decline to buy. Thus, optimists have voiced the view that the pay-per-use society is nothing to fear; if it is as obnoxious as it is made out to be, it will never come into existence. If consumers dislike information goods that are locked up with TPMs, those goods will languish on the shelves. Publishers, who are in business to make money, not to make a point, will get the message soon enough and will stop producing goods that they are unable to sell. TPMs will go the way of countless other failed consumer products that met and

were defeated by the harsh realities of the marketplace. This view has been enunciated by various commentators,[4] including a prominent Clinton Administration official during congressional consideration of the proposed DMCA.[5] Other commentators have expressed doubts about whether the voice of the consumer can tame what they perceive as the TPM monster.[6]

---

[4] *See* CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY 98 (1999) (explaining to entrepreneurs that use of TPMs may increase their sales but require them to lower prices, possibly reducing profits); Tom W. Bell, *Fair Use vs. Fared Use: The Impact of Automated Rights Management on Copyright's Fair Use Doctrine*, 76 N.C. L. REV. 557, 591 (1998) ("Absent proof of a very narrow category of circumstances, such as duress or misrepresentation, we can assume that contracts under fared use reflect the interests of those who choose to enter into them."); Robert P. Merges, *The End of Friction? Property Rights and Contract in the "Newtonian" World of On-Line Commerce*, 12 BERKELEY TECH. L.J. 115, 127 (1997) ("The low transaction costs in this market make search and negotiation quite easy, which means an alternative source for a given piece of content will almost always exist, thus reducing the chance that a party will have to accept onerous terms."); David Nimmer, *A Riff on Fair Use in the Digital Millennium Copyright Act*, 148 U. PA. L. REV. 673, 740 (2000) (stating that "market factors" may prevent the pay-per-use world from coming to be); Pamela Samuelson, *Intellectual Property and the Digital Economy:* Why the Anti-Circumvention Regulations Need to Be Revised, 14 BERKELEY TECH. L.J. 519, 566 (1999) ("If one information provider tightly locks up his content, a competing provider may see a business opportunity in supplying a less tightly restricted copy to customers who might otherwise buy from the first provider."); Ida Shum, Note, *Getting "Ripped" Off by Copy-Protected CDs*, 29 J. LEGIS. 125, 153 (2002) ("Record labels hesitate to move to a more secure format for digital music because of backlash from the public."); Pete Singer, Comment, *Mounting a Fair Use Defense to the Anti-Circumvention Provisions of the Digital Millennium Copyright Act*, 28 U. DAYTON L. REV. 111, 139 (2002) ("[U]sers could boycott certain copyright owners with rigid access control measures in favor of copyright owners whose access control measures are less rigid and designed to permit fair uses."); Lucas Graves, *Has TiVO Forsaken Us?*, WIRED, Nov. 2004, at 150, *at* http://www.wired.com/wired/archive/12.11/view.html?pg=3 ("If [consumers] don't like a narrower window in which to view programming, they won't purchase it. That'll send a message to the content owners.").

[5] *See WIPO Copyright Treaties Implementation Act; and Online Copyright Liability Limitation Act: Hearing Before the Subcomm. on Courts and Intellectual Property of the House Comm. on the Judiciary on H.R. 2281 and H.R. 2280*, 105th Cong. 54 (1997) [hereinafter *WIPO Treaties Hearings*] ("I do not believe that you need to do anything at this moment with regard to fair use. . . . We have no reason to believe that it will not apply fully, and I believe that the marketplace will take that into consideration.") (testimony of Bruce Lehman).

[6] *See* James Boyle, *Cruel, Mean, or Lavish? Economic Analysis, Price Discrimination and Digital Intellectual Property*, 53 VAND. L. REV. 2007, 2033 (2000) (discussing the difficulty facing a consumer who is attempting to decide rationally whether to buy an information good, since "to know what it is worth to you, you would need to know what it is, but if you know what it is, then you no longer need to purchase"); Julie E. Cohen, Lochner *in Cyberspace: The New Economic Orthodoxy of "Rights Management,"* 97 MICH. L. REV. 462, 521 (1998) ("There is . . . insufficient information from which to conclude that, in a mature market, vendors of sub-

To assess whether it is reasonable to expect that market forces will discipline publishers in their use of TPMs, thereby preventing the development of constraints on the use of information goods that the community of users does not desire, we need to understand both the factors that are relevant to a rational publisher's decision whether it should implement TPMs in its products and the empirical conditions on which these factors depend. I approach this task by developing an economic model of publisher decision making with respect to TPMs. This model, while situated within the neoclassical economic framework, differs from the standard approaches to modeling producers' decision making with respect to price and quantity. As I explain below, a customized model is required because implementation of TPMs cannot realistically be modeled either as a price increase or as a product characteristic that consumers dislike.

This new model provides several insights. It disaggregates the empirical conditions that affect a publisher's decision whether to implement TPMs to control uses of its information goods, illuminating the impact of several factors that a more traditional model conflates or ignores. Disaggregating these factors enables us to understand how considerations such as the undesirable side effects of a particular TPM implementation or its resistance to circumvention are factored into the publisher's decision. The model also recognizes that TPM implementation is not a binary, all-or-nothing proposition: there are different types of TPMs (some of which can be used in combination), yielding a range of possibilities that have varying implications for the publisher's bottom line.

Part I of this Article describes the most common forms of TPMs in current use. Part II sets out the history and operation of the DMCA's anticircumvention provisions. Part III explicates the double-edged nature of legally-backed TPMs: while TPMs

---

stitutable products will compete to offer less restrictive access terms."); Alfred C. Yen, *What Federal Gun Control Can Teach Us About the DMCA's Anti-Trafficking Provisions*, 2003 WIS. L. REV. 649, 695 ("[T]here is a significant risk that copyright holders will charge consumers an inappropriately high price for permission to exercise their rights of fair use and access to copyrighted works."); Chad Woodford, Comment, *Trusted Computing or Big Brother? Putting the Rights Back in Digital Rights Management*, 75 U. COLO. L. REV. 253, 255 (2004) ("Ultimately, it remains to be seen whether consumers will understand these subtle and potentially devastating technological changes and, more importantly, whether they will take a stand against them. Furthermore, it is unclear what manufacturers and other industry players will do if consumers do object.").

offer the benefit of providing copyright owners with a tool that enables them to vindicate their rights under the Copyright Act, this benefit comes at the cost of contracting the public domain, reducing access to information goods, inhibiting competition, and invading privacy.

Part IV develops an economic model that reflects some unusual features in the response of consumers to TPMs and in the costs that TPMs entail for publishers who decide to implement them. The publisher's decision whether to implement TPMs is shown to depend on a combination of three factors: two that have offsetting effects on consumer demand, and a cost factor. Part V demonstrates how the model applies to a range of market structures—pure competition, monopolistic competition, monopoly, and oligopoly—for several types of information goods.

Part VI sets out several historical examples of the application of TPMs to information goods and derives from those examples a set of empirical conditions that determine how consumer demand and publisher costs are affected by the implementation of TPMs.

## I

## VARIETIES OF TECHNOLOGICAL PROTECTION MEASURES

The technological protection measures addressed in this Article are systems that control access to or use of information goods. The most widely used TPMs are generally software-based[7] and rely on encryption together with some sort of authorization code that permits decryption.[8] The efficacy of widely used TPMs derives from the fact that information goods in digital formats cannot be usefully employed without some intermediary appliance, such as a computer, DVD player, or CD player, that translates the binary code constituting the stored work into text, sounds,

[7] Hardware-based TPMs are less common than software-based TPMs. There are devices called "dongles," also known as "hardware keys," which must be attached physically to a computer in order for the associated software to function. For example, in the mid-1990s, a CD version of the Encyclopaedia Britannica came with a dongle. *See* Seth Hamblin, *An A-to-Z Source Puts Its Hopes on CD*, WASH. POST, Dec. 31, 1997, at D10. It has been a while since dongles were in vogue. *See* John Gilroy, *Ask the Computer Guy*, WASH. POST, Dec. 12, 1994, at F22 ("[M]ostly the antipiracy dongle has gone the way of dinosaurs"). The copy protection device discussed in *Vault Corp. v. Quaid Software Ltd.*, 847 F.2d 255 (5th Cir. 1988), an anti-copy floppy diskette, was a hardware/software hybrid.

[8] For a discussion of the technologies underlying TPMs, see Kenneth W. Dam, *Self-Help in the Digital Jungle*, 28 J. LEGAL STUD. 393, 398-401 (1999).

graphics, or other modes of communication that humans can readily understand. Copyright-protected materials that are usable by humans without some intermediary device might in principle be protected by TPMs—for example, access to a hard-copy book could be restricted by the application of a TPM consisting of a wrapper secured by a padlock—but TPMs of this sort are not presently of much practical significance.[9]

Several varieties of TPMs are in common use, while others are in various stages of conception or development. First, and perhaps most common, are TPMs that prevent the user from making an unauthorized copy[10] of the information contained on a CD-ROM, DVD, floppy diskette, digital audio tape cassette, or any other material object holding a digital representation of text, computer source code, music, movies, or other copyrighted material. Examples of this type of TPM include the Content Scramble System, which is used to encode most commercially released movies on DVD and is licensed under conditions that require manufacturers of playback devices to prevent users from copying the material;[11] the Copy Switch, which is used in connection with streaming audio or video in RealNetworks' format;[12] and the Serial Copy Management System, which prevents multiple-generation copying of recordings on digital audio tape.[13]

---

[9] A frequently invoked metaphor characterizes evading a TPM as "the electronic equivalent of breaking into a locked room in order to obtain a copy of a book." H.R. REP. NO. 105-551, pt. 1, at 17 (1998). *See also WIPO Treaties Hearings*, *supra* note 5, at 49 ("Under existing law, it is not permissible to break into a locked room in order to make fair use of a manuscript kept inside.") (prepared statement of Marybeth Peters). The metaphor is inapt. Among other things, circumvention involves no physical trespass. *See* Charles Fried, *Perfect Freedom or Perfect Control?*, 114 HARV. L. REV. 606, 629 n.50 (2000) (book review).

[10] I use the term "unauthorized" to refer to conduct by consumers that the publisher would like to prevent. Not all unauthorized use is infringing use. A publisher might like to prevent consumers from making fair use of its product, publishing a critical review, reselling it on the secondary market, or lending a copy to a friend—none of which conflicts with the publisher's copyright.

[11] *See* 321 Studios v. Metro Goldwyn Mayer Studios, Inc., 307 F. Supp. 2d 1085, 1096 (N.D. Cal. 2004); Universal City Studios, Inc. v. Reimerdes, 111 F. Supp. 2d 294, 310 (S.D.N.Y. 2000), *aff'd sub nom.* Universal City Studios, Inc. v. Corley, 273 F.3d 429 (2d Cir. 2001).

[12] *See* RealNetworks, Inc. v. Streambox, Inc., No. 2:99CV02070, 2000 WL 127311, *2 (W.D. Wash. Jan. 18, 2000).

[13] *See* 17 U.S.C. § 1002 (2000) (requiring certain digital recording devices to be equipped with the "Serial Copy Management System"). This requirement applies to a rather narrow range of devices, excluding those devices which are currently of the greatest significance to copyright owners and publishers. *See* Recording Indus. Ass'n of Am. v. Diamond Multimedia Sys., Inc., 180 F.3d 1072 (9th Cir. 1999) (hold-

Second, there are "tethering" systems that limit the number of devices with which a particular copy can be used. For example, within the past few years, software publishers have begun protecting some of their products with an "activation" requirement. The software will not function until activated, which typically involves a communication between the user's computer and the publisher's server that results in a unique code number being recorded on the user's computer. After activation, the software will not function on any other computer unless the publisher grants permission upon special request. Some suppliers of music files in MP3 format use a tethering system that prevents the file from being played back on more than a designated number of playback devices. A similar system is used in connection with some electronic books.[14] The Content Scramble System (CSS) includes a feature called "region coding," which divides the world into seven regions and prevents a DVD designated for players made for one region from being played on a player made for another region. Some electronic gaming systems also feature region coding.[15]

Third, there are systems that limit how an information good may be used. For example, the Adobe Acrobat Reader software honors settings in a PDF document that control whether the document may be printed, modified, or combined with other documents. The DVD-Video standard enables a DVD publisher to prevent the viewer from engaging in certain actions, such as fast-forwarding through commercials, by inserting User Operation Prohibition (UOP) codes on the disc.[16]

Fourth, there are TPMs that control the transmission of content from one device to another. The proposed "broadcast flag" implements such a system. In 2003, the Federal Communications

---

ing that computer hard drives and portable MP3 players are not covered). Record labels are experimenting with new technology called "sterile burning," which similarly allows a copy to be made of a CD but prevents copying of the copies. *See BMG Cracks Piracy Whip*, WIRED, May 31, 2005, *at* http://www.wired.com/news/digiwood/0,1412,67696,00.html.

[14] *See* United States v. Elcom Ltd., 203 F. Supp. 2d 1111, 1117-19 (N.D. Cal. 2002) (describing the Adobe Acrobat eBook Reader tethering system).

[15] *See* Sony Computer Entm't Am. Inc. v. GameMasters, 87 F. Supp. 2d 976, 981 (N.D. Cal. 1999).

[16] *See* Connections—UOPs & Settings (User Operation Prohibitions), http://www.mediachance.com/dvdlab/Helppro/cnt_uops.htm (last visited Nov. 5, 2005); MSDN, The DVD Standard, http://msdn.microsoft.com/library/default.asp?url=/library/en-us/wcedvd/html/_wcesdk_dxdvd_the_dvd_standard.asp (last visited Nov. 5, 2005).

Commission (FCC) issued regulations mandating that all devices capable of receiving digital television broadcasts that are manufactured starting July 1, 2005 incorporate a system that recognizes the presence of a series of bits embedded in a broadcast indicating that the broadcaster has designated the material for controlled redistribution.[17] The FCC's regulations require that these devices be designed to honor the broadcaster's insertion of the indicator bits by preventing redistribution of the material to unapproved devices.[18] In 2005, the United States Court of Appeals for the District of Columbia Circuit invalidated the regulations on the ground that the FCC had exceeded its delegated authority in promulgating them.[19] At this writing, the broadcast industry is engaged in efforts to revive the regulations by seeking broadened FCC authority from Congress.[20]

On the horizon are efforts to develop "trusted computing" systems, which will control all computer operations in order to prevent a range of unauthorized actions. Microsoft is in the process of developing such a system, which was originally referred to as "Palladium" and, more recently, as the "Next-Generation Secure Computing Base." This system is associated with the promised next version of Windows, which is named "Windows Vista."[21]

## II

## THE ANTICIRCUMVENTION PROVISIONS OF THE DMCA

In 1998, Congress enacted a set of provisions designed to increase the efficacy of TPMs.[22] The weakness of TPMs, from the

[17] *In re* Digital Broadcast Content Protection, 18 F.C.C.R. 23,550 (2003).

[18] *Id.* app. B (proposed 47 C.F.R. § 73.9000-.9009). The broadcast flag system also incorporates a form of access control, limiting the types of devices on which a recorded program may be viewed, as well as a copy control, defining whether and how many times a program may be copied. *See* CENTER FOR DEMOCRACY AND TECHNOLOGY, IMPLICATIONS OF THE BROADCAST FLAG: A PUBLIC INTEREST PRIMER (VERSION 2.0) (Dec. 2003), *available at* http://www.cdt.org/copyright/broadcastflag.pdf.

[19] Am. Library Ass'n v. FCC, 406 F.3d 689 (D.C. Cir. 2005).

[20] *See* Eric A. Taub, *After Ruling, Broadcasters May Seek Congress's Help in HDTV Anti-Piracy Effort*, N.Y. TIMES, May 9, 2005, at C2.

[21] *See* Woodford, *supra* note 6, at 279-83; Microsoft, Next-Generation Secure Computing Base, http://www.microsoft.com/resources/ngscb/default.mspx (last visited Nov. 5, 2005). The next generation of Windows was originally codenamed "Longhorn," but has since been named "Windows Vista." *See id.*; Microsoft, Windows Vista, http://www.microsoft.com/windowsvista/default.mspx (last visited Nov. 5, 2005).

[22] Digital Millennium Copyright Act, Pub. L. No. 105-304, § 103, 112 Stat. 2860 (1998) (adding Chapter 12 to Title 17 of the U.S. Code).

standpoint of the publishers that deploy them, is that they are subject to circumvention. Some well-known examples of circumvention include the RAMKEY code, which defeats the PROLOK floppy diskette anti-copy system;[23] the DeCSS code, which defeats the CSS protection of DVDs;[24] and the Streambox technology, which defeats RealNetworks' Secret Handshake and Copy Switch.[25] Software that defeats a TPM can be quickly, cheaply, and widely distributed via the Internet, with the result that when one person devises a circumvention technology, all applications of the TPM worldwide are potentially compromised. Prior to the enactment of the DMCA, some publishers expressed an unwillingness to release their products in digital formats unless TPMs could be secured against circumvention.[26] Unauthorized copying of digital information goods is of particular concern to publishers since, unlike information goods in analog formats, digital goods can be copied through multiple generations with no degradation in quality and can be distributed nearly costlessly via digital networks.

Rules banning devices designed to circumvent TPMs were proposed in a 1995 report issued by the Clinton Administration's Information Infrastructure Task Force.[27] When Congress did not adopt the Task Force's proposal, the U.S. delegation to the World Intellectual Property Organization (WIPO) introduced a similar proposal in the context of negotiations to develop what ultimately became two 1996 treaties that updated the international copyright legal regime.[28] WIPO adopted a watered-down ver-

---

[23] *See* Vault Corp. v. Quaid Software Ltd., 847 F.2d 255 (5th Cir. 1988).

[24] *See* Universal City Studios, Inc. v. Reimerdes, 111 F. Supp. 2d 294 (S.D.N.Y. 2000), *aff'd sub nom.* Universal City Studios, Inc. v. Corley, 273 F.3d 429 (2d Cir. 2001).

[25] *See* RealNetworks, Inc. v. Streambox, Inc., No. 2:99CV02070, 2000 WL 127311 (W.D. Wash. Jan. 18, 2000).

[26] *See Reimerdes*, 111 F. Supp. 2d at 304 ("Proponents of strong restrictions on circumvention of access control measures argued that they were essential if copyright holders were to make their works available in digital form because digital works otherwise could be pirated too easily."); Dan L. Burk & Julie E. Cohen, *Fair Use Infrastructure for Rights Management Systems*, 15 HARV. J.L. & TECH. 41, 47-48 & n.20 (2001).

[27] INFORMATION INFRASTRUCTURE TASK FORCE, INTELLECTUAL PROPERTY AND THE NATIONAL INFORMATION INFRASTRUCTURE: THE REPORT OF THE WORKING GROUP ON INTELLECTUAL PROPERTY RIGHTS (1995) (hereinafter INFO. INSTRACTURE TASK FORCE), *available at* http://www.uspto.gov/web/offices/com/doc/ipnii/ipnii.pdf.

[28] WIPO Copyright Treaty, Dec. 20, 1996, S. TREATY DOC. NO. 105-17 (1997), *available at* http://www.wipo.int/treaties/en/ip/wct/index.html; WIPO Performances

sion of the U.S. proposal in the form of a provision in each treaty requiring signatory states to "provide adequate legal protection and effective legal remedies against the circumvention of effective technological measures" used to protect copyrighted works.[29] Congress then enacted the DMCA's anticircumvention provisions for the stated purpose of implementing these treaty provisions.[30]

The anticircumvention provisions principally prohibit three types of conduct. First, it is forbidden to "circumvent a technological measure that effectively controls access to a work protected" under the copyright laws.[31] Second, it is forbidden to traffic in any technology that can be used to circumvent such access controls if the technology is "primarily designed" for that purpose, has no significant commercial purpose other than to facilitate circumvention, or is marketed as a circumvention device.[32] Third, it is forbidden to traffic in a technology that can be used for "circumventing protection afforded by a technological measure that effectively protects a right of a copyright owner" under the copyright laws, if any of the circumstances applying to access-circumvention devices is present.[33]

The difference between the second and third prohibitions is difficult to discern from the face of the statute.[34] The second refers to devices that permit unauthorized *access*, while the third refers to devices that enable unauthorized exercise of any of the copyright owner's *exclusive rights*, such as copying.

The provisions thus ban *trafficking* in both devices that circumvent access controls and devices that circumvent use controls. But this symmetrical approach does not extend to the *act of using* such devices to circumvent TPMs: while the act of circumventing an *access* control is forbidden, the act of circumventing a

---

and Phonograms Treaty, Dec. 20, 1996, S. TREATY DOC. NO. 105-17 (1997), *available at* http://www.wipo.int/treaties/en/ip/wppt/index.html.

[29] WIPO Copyright Treaty, *supra* note 28, art. 11; WIPO Performances and Phonograms Treaty, *supra* note 28, art. 18.

[30] S. REP. NO. 105-190, at 8 (1998). For the history of these provisions, see Pamela Samuelson, *The U.S. Digital Agenda at WIPO*, 37 VA. J. INT'L L. 369, 409-15 (1997). The wording of the DMCA's provisions is closer to that of the IITF report's proposal and to that of the U.S. delegation's proposal to WIPO than it is to the final treaty language.

[31] 17 U.S.C. § 1201(a)(1)(A) (2000).

[32] *Id.* § 1201(a)(2).

[33] *Id.* § 1201(b)(1).

[34] *See* David Nimmer, *Appreciating Legislative History: The Sweet and Sour Spots of the DMCA's Commentary*, 23 CARDOZO L. REV. 909, 947-49 (2002).

*use* control is not. The justification for this is simple; the ramifications, though, are a bit more subtle. There is no need to ban the act of circumventing a use control because such an act is already forbidden by the Copyright Act as an unauthorized exercise of one of the copyright owner's exclusive rights, and Congress did not wish to modify the grounds of such liability.[35] The three types of conduct that section 1201 does ban (trafficking in devices that circumvent access controls, trafficking in devices that circumvent use controls, and the act of circumventing an access control) do not constitute infringement under the Copyright Act—hence the need for these new prohibitions.

Because the act of circumventing a use control violates only the Copyright Act (and not the anticircumvention provisions), such an act is no violation if it lies within one of the exceptions to infringement liability contained within the Copyright Act.[36] The three broadest and most important exceptions are the privilege of fair use,[37] the exclusion of protection for ideas (as opposed to expression),[38] and the first-sale doctrine.[39] One who is authorized to access a work protected by a TPM is therefore free to circumvent a *use* control for the purpose of engaging in fair use or in any other conduct permitted by the Copyright Act. As a practical matter, however, most people will be unable to exercise this right since it is probably unlawful for anyone to supply the technology necessary to circumvent the control.[40]

---

[35] S. REP. NO. 105-190, at 12.

[36] Section 106 sets out the exclusive rights of a copyright owner, but it explicitly makes them "[s]ubject to sections 107 through 122" of the Act. 17 U.S.C.A. § 106 (2005).

[37] *Id.* § 107.

[38] *Id.* § 102(b).

[39] *Id.* § 109(a) (limiting the distribution right); *id.* § 109(c) (limiting the display right). Other limitations on the exclusive rights include privileges for libraries, *id.* § 108; exemption of certain performances and displays, *id.* § 110; exemptions and statutory licenses for certain digital transmissions of sound recordings, *id.* § 114(d), (f); compulsory licensing of mechanical reproductions of musical works, *id.* § 115; and copying computer programs for use and backup, *id.* § 117. Section 108, added in 1992 by the Audio Home Recording Act, is also a limitation on the section 106 rights, providing that the making of certain types of musical recordings is not actionable as infringement under section 106.

[40] *See* Nimmer, *supra* note 4, at 739-40 ("If the courts apply section 1201 as written, the only users whose interests are truly safeguarded are those few who personally possess sufficient expertise to counteract whatever technological measures are placed in their path."); R. Anthony Reese, *Will Merging Access Controls and Rights Controls Undermine the Structure of Anticircumvention Law?*, 18 BERKELEY TECH. L.J. 619, 630-33 (2003) (discussing whether section 1201 bans trafficking in a use-

However, fair use and the Copyright Act's other limitations on the exclusive rights are not available to justify an act of circumventing an *access* control. As one court explained,[41] Congress chose to balance the interests of copyright owners and users with respect to the anticircumvention rules not by importing the limitations on infringement liability from the Copyright Act but by crafting a set of exceptions to section 1201 liability for circumventing access controls[42] and by providing a mechanism by which the Librarian of Congress may create additional exceptions through triennial rulemaking proceedings.[43]

Since access controls thus enjoy greater protection under section 1201 than do use controls, it is natural to expect that publishers that use TPMs and want to exercise maximum control will always include an access control even if they are concerned only with preventing infringing uses.[44] By doing so, they render unavailable to users the fair use privilege and all other limitations on the exclusive rights contained in the Copyright Act.

## III

## THE DETRIMENTS OF LEGALLY BACKED TPMS

TPMs, and the legal sanctions of section 1201 that support them, are designed to give publishers increased control over ac-

---

control circumvention technology that is designed to allow consumers to engage in uses permitted under the Copyright Act).

[41] Universal City Studios, Inc. v. Reimerdes, 111 F. Supp. 2d 294, 322-24 (S.D.N.Y. 2000), *aff'd sub nom.* Universal City Studios, Inc. v. Corley, 273 F.3d 429 (2d Cir. 2001).

[42] The exceptions include a shopping privilege for libraries, the right to reverse engineer a computer program to determine how to construct a program that will interoperate with it, permission to engage in limited types of encryption research, and permission to disable privacy-invading technologies. 17 U.S.C. § 1201(d), (f), (g), (i) (2000).

[43] *Id.* § 1201(a)(1)(B)-(E). The two rulemakings that have been conducted so far have exempted very narrow classes of works. *See* Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies, 68 Fed. Reg. 62,011, 62,013-14 (Copyright Office, Oct. 31, 2003) (codified at 37 C.F.R. § 201.40) (exempting lists of sites blocked by filtering software, computer programs protected by broken dongles, programs in obsolete formats, and e-books with the read-aloud function disabled); Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies, 65 Fed. Reg. 64,556, 64562 (Copyright Office, Oct. 27, 2000) (codified at 37 C.F.R. § 201.40) (exempting only two categories of works). The exemption allows circumvention of access controls for noninfringing uses only.

[44] *See* Reese, *supra* note 40, at 640-41 (suggesting that publishers will have an incentive to employ "merged" access and copy controls).

cess to and use of their products. Policymakers hope that the availability of these tools will encourage publishers to release their products in digital formats. Should we be concerned about the possibility that publishers may overuse these technologies?

This Part discusses four detrimental effects that result from publishers' use of TPMs: contraction of the public domain, constricted access to digital information goods, harm to competition, and invasion of privacy. The existence of these detriments means that expanded use of TPMs is not an unalloyed benefit to society.

### *A. Contraction of the Public Domain*

A copyrighted work is in the public domain to the extent that it may be used freely by others without any need to obtain authorization from the copyright owner.[45] One element that goes into the construction of the public domain is the set of limitations on the copyright owner's exclusive rights that are built into the Copyright Act. These limitations allow one to make a variety of public and private uses of a copyrighted work with no need to obtain permission from the copyright owner.[46]

The availability of TPMs, augmented by the section 1201 prohibition on circumventing (or supplying the means of circumventing) such controls, enables publishers to remove some of these uses from the public domain. A TPM that prevents copying the contents of a music CD onto a cassette tape may make it impossible to play a song in a classroom equipped only with a

[45] This use of the term "public domain" is broader than the definition one might find in the dictionary. According to the dictionary definition, the public domain consists of works that are free of any control by a copyright owner, such as works whose term of copyright protection has expired and those that never qualified for copyright protection in the first place. *See* Jessica Litman, *The Public Domain*, 39 EMORY L.J. 965, 975 (1990) (referring to a dictionary definition). I use the term in a broader sense, extending it to *particular uses* of a work that are unconstrained by copyright even if other uses are within the copyright owner's control. For justification of this broader use, see *id.* at 976; Yochai Benkler, *Free as the Air to Common Use: First Amendment Constraints on Enclosure of the Public Domain*, 74 N.Y.U. L. REV. 354, 361-62 (1999). *See also* James Boyle, *Foreword: The Opposite of Property?*, 66 LAW & CONTEMP. PROBS. 1, 30 (2003) (observing that one's definition of the public domain depends both on the "granularity" with which particular uses of a work are disaggregated and on whether merely formal free availability is considered sufficient). As Michael Carroll has pointed out to me, an object can be in the public domain with respect to one strand of intellectual property while also protected by another strand; for example, a fact might be in the public domain with respect to copyright but be protected under trade secret law.

[46] *See* sources cited *supra* notes 37-39, which enumerate limitations on the exclusive rights of the copyright owner.

cassette player.[47] Copy controls prevent fair use copying of streaming video that would allow the video to be shown at a location lacking a live Internet connection. The CSS TPM that protects a movie DVD makes it impossible to compile a series of clips for critical or classroom use, and the region-coding system prevents lending or selling a U.S.-designated DVD to a user in Europe or Japan. Applying the anti-copy setting to a PDF document makes it impossible to cut and paste small portions of text, and the anti-print setting interferes with use of the document. The proposed broadcast flag[48] would limit the ability of consumers to "time-shift" and "space-shift" television broadcasts.[49] Public domain materials that are combined with protected materials and locked up with a TPM are functionally removed from the public domain. To the extent that public domain materials cease to be available in formats other than ones protected by TPMs, those materials may be converted entirely from public domain to pay-per-use status.[50] The existence of TPMs that make it feasible for publishers to charge licensing fees for a particular use tends to lead courts to a determination that such uses are not within fair use.[51]

It is true that there are often workarounds: the output of a CD player may be recorded by using a microphone attached to a cassette recorder, and video output may be captured by using a video camera pointed at the display on a television screen or computer monitor.[52] But it remains true that TPMs cut back on the scope and usefulness of the fair use limitation on the exclusive rights of the copyright owner.

---

[47] Since a cassette tape is an analog recording medium, the making of such a copy does not constitute infringement. *See* 17 U.S.C. § 1008 (2000).

[48] For more on the broadcast flag, see *supra* notes 17-20 and accompanying text.

[49] *See* CENTER FOR DEMOCRACY AND TECHNOLOGY, *supra* note 18, at 23. In *Sony Corp. v. Universal City Studios, Inc.*, 464 U.S. 417, 454-55 (1984), the Supreme Court held that time-shifting of analog television broadcasts for noncommercial purposes in the home is a fair use.

[50] *See* Nimmer, *supra* note 4, at 713.

[51] *See, e.g.*, INFO. INFRASTRUCTURE TASK FORCE, *supra* note 27, at 79-82 (discussing judicial interpretation of the fourth fair use factor); Bell, *supra* note 4, at 567-71 (same).

[52] *See* Universal City Studios, Inc. v. Corley, 273 F.3d 429, 459 (2d Cir. 2001) (noting that fair use may be made of a TPM-protected movie through "recording portions of the video images and sounds on film or tape by pointing a camera, a camcorder, or a microphone at a monitor as it displays the DVD movie"); 321 Studios v. Metro Goldwyn Mayer Studios, Inc., 307 F. Supp. 2d 1085, 1102 (N.D. Cal. 2004) (same).

In theory, circumvention of a use control to engage in fair use is neither a violation of section 1201 nor an infringement of the copyright owner's exclusive rights; as a practical matter, however, few will be able to exercise this right because the trafficking ban makes circumvention technologies hard to acquire. Moreover, to the extent that publishers deploy access controls, circumvention is a violation of section 1201 even if done to enable a fair use (unless one of section 1201's own exceptions is applicable).

Another building block of the public domain is the absence of copyright protection for what are generically called "ideas," which thus confines protection to "expression."[53] Among other things, the idea/expression dichotomy excludes protection for facts while retaining the possibility of protection for the selection and arrangement of facts.[54] Because facts per se are not protected by copyright, they are also not protected by the anticircumvention rules since each of the three anticircumvention prohibitions is limited by its terms to copyright-protected works.[55] However, when facts are conjoined with copyrighted expression and are locked up by means of a use control, the facts gain de facto protection because of the unavailability of technology for circumventing a use control.[56]

A third source of public domain material is the expiration of copyright protection after the running of its term. Currently, the term of copyright protection lasts until seventy years after the death of the author or, in the case of a work made for hire, ninety-five years after publication.[57] TPMs, however, last forever. There is no requirement that TPMs incorporate a mechanism that renders them ineffective after a certain date, and I am

---

[53] 17 U.S.C. § 102(b) (2000) ("In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery . . . .").

[54] The exclusion of facts from copyright protection is an aspect of the constitutionally mandated "originality" requirement. Feist Publ'ns, Inc. v. Rural Tel. Serv. Co., 499 U.S. 340, 347-48 (1991).

[55] 17 U.S.C. § 1201(a)(1)(A) (prohibiting circumvention of a technological measure that controls "access to a work protected under this title"); *id.* § 1201(a)(2) (same); *id.* § 1201(b)(1) (prohibiting trafficking in a technology designed to circumvent a technological measure that protects "a right of a copyright owner under this title in a work").

[56] *See* Haimo Schack, *Anti-Circumvention Measures and Restrictions in Licensing Contracts as Instruments for Preventing Competition and Fair Use*, 2002 U. ILL. J. L. TECH. & POL'Y 321, 326-27 (noting that anticircumvention rules create "new monopolies in unprotected information [and] in simple databases").

[57] 17 U.S.C. § 302.

unaware of any TPM technology that includes such a feature. Deployment of TPMs thus effectively makes the duration of copyright perpetual.[58]

We should take care not to overstate the impact of this perpetual extension of copyright. The length of the copyright term, combined with the pace of technological change, means that the perpetuity of TPMs is irrelevant in most cases. By the time the term of copyright expires, 70, 95, or 120 years hence, copyrighted material stored now in a digital format will be unusable, TPM-protected or not, because the equipment needed to render the material audible or viewable will be obsolete. However, TPMs *will* effectively extend the term of copyright if they are used to lock up a work that is near the end of its term.

### *B. Reduced Access to Digital Information Goods*

Another effect of the availability of legally backed TPMs to reinforce copyright protection is the potential elimination of the secondary market for information goods, which has the effect of reducing access to those goods. Tethering technology is the primary source of this effect. A software copy encumbered by a tethering measure that allows it to be used only on the original purchaser's computer cannot be sold on the secondary market. It also cannot be loaned by a library to the public or by an individual to a friend.[59] This is despite the fact that the copyright laws do not grant publishers any right to prevent the owner of a copy of a computer program from loading the program on a computer and using it.[60] Tethering TPMs are not widely used at present in

---

[58] *See* Universal City Studios, Inc. v. Reimerdes, 111 F. Supp. 2d 294, 322 n.159 (S.D.N.Y. 2000) ("[T]echnological means of controlling access to works create a risk, depending upon future technological and commercial developments, of limiting access to works that are not protected by copyright such as works upon which copyright has expired."), *aff'd sub nom.* Universal City Studios, Inc. v. Corley, 273 F.3d 429 (2d Cir. 2001).

[59] One consequence of the first-sale doctrine is that library lending of software copies is not within the copyright owner's control. 17 U.S.C. § 109(b)(2)(A) (2000). Individual lending of a software copy is likewise permitted as long as it is not done for purposes of commercial advantage. *See id.* § 109(b)(1)(A).

[60] *Id.* § 117(a). Despite frequent claims by software publishers to the contrary, the fact that software is distributed subject to a license agreement does not prevent transfer of ownership of the material object in which it is embodied and, therefore, does not defeat the user's right under section 109(a) to sell the copy on the secondary market or the secondary purchaser's right under section 117(a) to use the program on a computer. *See* John A. Rothchild, *The Incredible Shrinking First-Sale Rule: Are Software Resale Limits Lawful?*, 57 RUTGERS L. REV. 1 (2004).

connection with music CDs or movie DVDs,[61] but at some point publishers might find it expedient to implement such controls, which would make it impossible to use protected copies borrowed from a library and would put DVD-rental stores out of business.

Resale and lending of copies containing copyrighted materials is an important means of broadening access to those materials.[62] Not everyone is able or willing to pay the full retail price for a computer program, music CD, or movie DVD. If a copy is available for sale on the secondary market, such potential users can become actual users.[63] Consumers with lower levels of resources or interest who are willing to make do with temporary access can obtain copyrighted materials at no cost through library borrowing.

The shift to a pay-per-use market for information goods might depress use of those goods for reasons beyond the tethering restriction. First, absent some breakthrough in the system for assessing usage fees, pay-per-use is likely to entail high transaction costs in terms of the time and attention that users would be required to devote to deciding whether to purchase a particular unit of content.[64] Second, if users must pay for each unit of access, they will face a disincentive against perusing material that is of unknown value. Third, reduced access can also result when an authorization code required to gain access to an information good becomes lost or separated from the copy of the good, thus rendering it unusable.[65]

On the other hand, TPMs may have a countervailing effect of

---

[61] Note, however, that a limited form of tethering, region coding, is in widespread use in connection with movie DVDs. *See supra* text accompanying note 15.

[62] *See* Wendy J. Gordon, *Intellectual Property as Price Discrimination: Implications for Contract*, 73 CHI.-KENT L. REV. 1367, 1388-89 (1998).

[63] For example, Amazon.com recently offered Quicken 2005 Deluxe personal finance software for $53.99. At the same time, its Amazon Marketplace Sellers (third parties who offer items via Amazon.com's website) offered 29 new and used copies of the same software at a range of prices starting at $15.44.

[64] *See* Clay Shirky, *The Case Against Micropayments*, Dec. 19, 2000, http://www.openp2p.com/pub/a/p2p/2000/12/19/micropayments.html ("Micropayments . . . waste the users' mental effort in order to conserve cheap resources, by creating many tiny, unpredictable transactions. Micropayments thus create in the mind of the user both anxiety and confusion . . . .").

[65] The exceptions to the ban on circumventing access controls that the Librarian of Congress created, discussed *supra* in note 43, allow circumvention to overcome malfunctioning hardware-based controls ("dongles") but not to overcome a lost authorization code, which is software-based.

promoting access by facilitating the operation of price discrimination. By charging different users different prices for the same good based on how highly each user values the good, a publisher can broaden access to the good by charging a lower price to lower-valuing users.[66] Price discrimination can succeed only if the publisher can prevent arbitrage, which occurs when a lower-valuing user resells a good to a higher-valuing user.[67] A tethering TPM can prevent arbitrage by making an information good useless except when used by the original purchaser.

The benefits of price discrimination, however, should not be overstated. First, a tethering TPM can prevent arbitrage only if it succeeds in associating a copy of an information good with the user's computer (or other intermediary device) at the time of purchase rather than at the time of later use. Otherwise, the lower-valuing user can resell the good before installing or otherwise using it, and the tethering will take effect only upon use by the higher-valuing user. This greatly limits the types of information goods as to which tethering can promote price discrimination. Second, price discrimination has distributional consequences that must be taken into account. In particular, price discrimination leaves less surplus in the hands of consumers and shifts more surplus to publishers. Indeed, perfect price discrimination shifts the *entire* surplus to publishers.[68] Third, price discrimination is costly to implement and can be accomplished only imperfectly, because sellers can never do better than a rough approximation of a consumer's valuation of the product,[69] because it is costly for sellers to gather the information needed to engage in price discrimination, and because it is often costly for consumers to participate in price discrimination.[70] These extra

---

66 *See* William W. Fisher III, *Property and Contract on the Internet*, 73 CHI.-KENT L. REV. 1203, 1238-39 (1998) (showing the economic effect of price discrimination).

67 *See* Michael J. Meurer, *Price Discrimination, Personal Use and Piracy: Copyright Protection of Digital Works*, 45 BUFF. L. REV. 845, 869-70, 874-76 (1997) (discussing arbitrage).

68 *See* HAL R. VARIAN, INTERMEDIATE MICROECONOMICS 435 (5th ed. 1999).

69 *See* Yochai Benkler, *An Unhurried View of Private Ordering in Information Transactions*, 53 VAND. L. REV. 2063, 2072 (2000) ("Price discrimination, if you will, can never be perfect, but is always lumpy.").

70 Recently, I spent a half hour or more filling out and mailing three rebate forms, and I will likely be required to waste even more time when the rebates fail to arrive and I have to make a follow-up inquiry. Rebates are a means of implementing price discrimination. *See* F.M. SCHERER & DAVID ROSS, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 493 (3d ed. 1990).

costs and mismatches between consumer valuation and offering price detract from broadened access.

### *C. Harm to Competition and Innovation*

TPMs may be deployed and enforced in a manner that impedes competition and innovation, with respect to both information goods and ordinary manufactured goods.

#### *1. Keeping Proprietary File Formats Proprietary*

Apple Computer has rattled the DMCA saber to leverage the popularity of its iPod digital music player so as to protect its iTunes music download service from competition. Music downloaded from iTunes is in a proprietary format that works only on iPod players.[71] RealNetworks, a competitor in the market for music downloads, released software that converts music from RealNetworks's format to Apple's format, thereby allowing music purchased from RealNetworks to be played on iPods.[72] If Apple were successful in establishing that the RealNetworks software is an illegal circumvention technology, the effect would be anticompetitive.

#### *2. Inhibiting Reverse Engineering*

A software developer may find it necessary to analyze computer code written by someone else for a variety of purposes, many of which promote competition and innovation.[73] To en-

---

[71] *See* BERKMAN CENTER FOR INTERNET & SOCIETY, ITUNES: HOW COPYRIGHT, CONTRACT, AND TECHNOLOGY SHAPE THE BUSINESS OF DIGITAL MEDIA—A CASE STUDY 11 (June 15, 2004), *available at* http://cyber.law.harvard.edu/media/uploads/81/iTunesWhitePaper0604.pdf.

[72] *See* GARTNERG2 & BERKMAN CENTER FOR INTERNET & SOCIETY, COPYRIGHT AND DIGITAL MEDIA IN A POST-NAPSTER WORLD 46 (Version 2 Updated Jan. 2005), *available at* http://cyber.law.harvard.edu/media/files/wp2005.pdf; Cynthia L. Webb, *No Synchronicity for Apple, RealNetworks*, WASHINGTONPOST.COM, July 30, 2004, http://www.washingtonpost.com/wp-dyn/articles/A27081-2004Jul30.html (quoting Apple CEO Steve Jobs as saying, "We are stunned that RealNetworks has adopted the tactics and ethics of a hacker to break into the iPod, and we are investigating the implications of their actions under the [Digital Millennium Copyright Act] and other laws.") (alteration in original).

[73] These purposes include "locating, assessing, and fixing bugs in software; analyzing software to understand how to add additional features; understanding the internal design of a technical protection measure for research purposes; understanding its internal design to develop a competing product; understanding its internal design in order to make a compatible product, such as an alternative nonsoftware platform [and] analyzing a technical measure to enable interoperability with data." Pamela

gage in this sort of analysis, which is known as "reverse engineering," it is necessary to gain access to the code, and it is generally also necessary to copy the code. If the code is protected by a TPM, gaining the necessary access may be both difficult and, because of the anticircumvention rules, unlawful.[74] While the anticircumvention rules contain an exception permitting reverse engineering,[75] this exception is quite narrow in scope.[76]

### 3. *Interfering with Encryption Research*

A ban on circumvention makes it risky to engage in encryption research.[77] Several high-profile incidents have brought this risk home to legitimate researchers. In one case, Dmitry Sklyarov, a Russian researcher, was arrested after he delivered a paper at a conference. In the paper, Sklyarov described a program he had developed that disabled the encryption system employed by the Adobe Acrobat eBook. Although Sklyarov was later released, federal officials prosecuted ElcomSoft Co. Ltd., the Russian company that employed him (and that also sold the decryption program), for violating section 1201.[78] ElcomSoft was acquitted by a jury verdict.[79] In another case, Princeton University Profes-

---

Samuelson & Suzanne Scotchmer, *The Law and Economics of Reverse Engineering*, 111 YALE L.J. 1575, 1642 (2002).

[74] Under at least some circumstances, copying the code will be a fair use and thus neither a copyright infringement nor a violation of the anticircumvention rules. *See* Atari Games Corp. v. Nintendo of Am., Inc., 975 F.2d 832, 844 (Fed. Cir. 1992) ("Atari did not violate Nintendo's copyright by deprocessing computer chips in Atari's rightful possession. Atari could lawfully deprocess Nintendo's 10NES chips to learn their unprotected ideas and processes."); Sega Enters. Ltd. v. Accolade, Inc., 977 F.2d 1510, 1527-28 (9th Cir. 1992) ("[W]here disassembly is the only way to gain access to the ideas and functional elements embodied in a copyrighted computer program and where there is a legitimate reason for seeking such access, disassembly is a fair use of the copyrighted work, as a matter of law.").

[75] 17 U.S.C. § 1201(f) (2000).

[76] *See* Davidson & Assocs., Inc. v. Internet Gateway, 334 F. Supp. 2d 1164, 1184-87 (E.D. Mo. 2004) (finding online multiplayer game server emulator is not within exception as it fails the "sole purpose" and "independently created computer program" criteria); Samuelson & Scotchmer, *supra* note 73, at 1635 n.289 (explaining that § 1201(f) is narrower than the exception recognized in *Sega v. Accolade*).

[77] *See* NIVA ELKIN-KOREN & ELI M. SALZBERGER, LAW, ECONOMICS AND CYBERSPACE 60 (2004) ("Anti-circumvention restrictions inevitably cover large chunks of encryption research and other research fields in computer science.").

[78] Although the program could be used in a way that infringed copyright, it also had noninfringing fair uses. *See* United States v. Elcom Ltd., 203 F. Supp. 2d 1111, 1118-19 (N.D. Cal. 2002).

[79] *See* Matt Richtel, *Russian Company Cleared Of Illegal Software Sales*, N.Y. TIMES, Dec. 18, 2002, at C4.

sor Edward Felten was threatened with legal action if he should present a paper explaining a method of cracking an encryption system for protecting digital audio called the Secure Digital Music Initiative—a method that he devised in response to a public challenge issued by the developers of the encryption system.[80]

### 4. *Lock-out Codes*

Harm to competition can also occur when copyright-protected computer programming code is used to interface with an authorization code that allows the components of a machine to interoperate. It is not clear whether section 1201 is available to enforce efforts to suppress competition, but a few cases are suggestive.

In *Sony Computer Entertainment America Inc. v. GameMasters*,[81] Sony sued the seller of the Game Enhancer, a device that plugs into Sony's PlayStation electronic game console and modifies the operation of CD-ROM-based games that are played on the console. Among other things, the Game Enhancer enables the console to play games on CD-ROMs that contain a region code that would ordinarily prevent the game from being played on a console designed for a different region. In this case, users of consoles manufactured for sale in the United States were enabled to play games encoded for play on consoles manufactured for sale in Japan or Europe. The court agreed with Sony's argument that the Game Enhancer "circumvents the mechanism on the PlayStation console that ensures the console operates only when encrypted data is read from an authorized CD-ROM" and concluded that Sony was likely to succeed in proving a violation of the section 1201(a)(2) ban on trafficking in access-circumvention devices.[82]

On the facts of this case, the application of section 1201 had only a limited effect in suppressing competition: it allowed Sony to prevent competition between CD-ROMs that it designated for distribution in the United States and those that it designated for distribution in Japan or Europe. But the court's rationale seems

---

[80] *See* Pamela Samuelson, *Anticircumvention Rules: Threat to Science*, SCIENCE, Sept. 14, 2001, at 2028. Felten sued for a determination that publication of his paper would not violate the DMCA, but his case was dismissed. *See* John Schwartz, *2 Copyright Cases Decided in Favor of Entertainment Industry*, N.Y. TIMES, Nov. 29, 2001, at C4.

[81] 87 F. Supp. 2d 976 (N.D. Cal. 1999).

[82] *Id.* at 987-88.

to permit a publisher to use TPMs and section 1201 to enforce a more thoroughgoing suppression of competition. For example, an encrypted code on Sony-authorized CD-ROMs could be used to lock out games manufactured by Sony's competitors. Any method used to fool the PlayStation console into accepting the unauthorized game would constitute circumvention of an access control, and sellers of those games would be trafficking in banned devices.

Two other cases present scenarios in which manufacturers have been unsuccessful in their attempts to suppress competition by invoking section 1201. In *Lexmark International, Inc. v. Static Control Components, Inc.*,[83] Lexmark sued a computer chip producer whose chips were incorporated into aftermarket toner cartridges manufactured by third parties. Lexmark's printers contain a computer program called the Printer Engine Program that interacts with a computer chip on the toner cartridges that Lexmark manufactures. If the chip furnishes the Printer Engine Program with the correct authentication sequence, the printer operates normally; if not, the printer refuses to function. Static Control manufactures a chip called SMARTEK containing code identical to the code in the chips that Lexmark installs in its toner cartridges. Static Control sells the chips to third parties that remanufacture toner cartridges that Lexmark has designated to be used only once and then returned to Lexmark. The SMARTEK chip allows these remanufactured cartridges to provide the Printer Engine Program with the requisite authentication sequence and therefore allows the cartridges to operate in a Lexmark printer.

Lexmark argued that the SMARTEK chip was a device designed to circumvent the authentication sequence, which Lexmark characterized as a technological measure that "effectively controls access" to the Printer Engine Program and to the code in the toner cartridge chip.[84] The district court granted Lexmark a preliminary injunction, finding that it was likely to succeed in proving that Static Control violated the section 1201(a)(2) ban on trafficking in devices that circumvent access

---

[83] 387 F.3d 522 (6th Cir. 2004).

[84] For a device to violate the ban on circumventing access controls, it must defeat a technological measure that "effectively controls access" to a copyrighted work. 17 U.S.C. § 1201(a)(2) (2000).

controls by manufacturing the SMARTEK chip.[85]

The appellate court disagreed. It held that the authentication sequence did not qualify as a technological measure that "effectively controls access" to the Printer Engine Program since that program, which was not encrypted and could be read directly from the printer's memory, was freely accessible to anyone in possession of the printer.[86] As the court explained: "Just as one would not say that a lock on the back door of a house 'controls access' to a house whose front door does not contain a lock . . . , it does not make sense to say that this provision of the DMCA applies to otherwise-readily-accessible copyrighted works."[87]

This rationale would appear to be easily evadable by a manufacturer that wished to use the anticircumvention rules to prevent interoperability with a competitor's products. It would be simple enough for Lexmark to encrypt the Printer Engine Program and include the key needed to unlock it within the toner cartridge chip. Yet other language in the court's opinion suggested a broader rejection of the invocation of section 1201 for anticompetitive purposes. The court drew a distinction between the copyrightable expression that Lexmark sought to protect, which has no purpose but to control the functioning of a piece of machinery, and expression of the sort that is encoded on CDs and DVDs, which is translated into music and movies that have the purpose of acting on the human senses. The court seemed to indicate that only the latter sort of copyrighted expression is entitled to the protection of the anticircumvention rules.[88] In addition, a concurring judge explicitly declined to accept an interpretation of section 1201 that would aid a manufacturer in suppressing competition.[89]

Another case in which a manufacturer sought to use section 1201 to suppress competition is *Chamberlain Group, Inc. v. Skylink Technologies, Inc.*[90] Plaintiff Chamberlain, a manufac-

---

[85] *See* Lexmark Int'l, Inc. v. Static Control Components, Inc., 253 F. Supp. 2d 943 (E.D. Ky. 2003), *vacated*, 387 F.3d 522 (6th Cir. 2004).

[86] *Lexmark*, 387 F.3d at 549.

[87] *Id.* at 547.

[88] *Id.* at 548.

[89] *See id.* at 552 (Merritt, J., concurring) ("If we were to adopt Lexmark's reading of the statute, manufacturers could potentially create monopolies for replacement parts simply by using similar, but more creative, lock-out codes. Automobile manufacturers, for example, could control the entire market of replacement parts for their vehicles by including lock-out chips.").

[90] 381 F.3d 1178 (Fed. Cir. 2004).

turer of garage door openers, invoked the anticircumvention rules in an effort to prevent defendant Skylink from manufacturing aftermarket handheld transmitters that would operate Chamberlain's garage doors. The two companies were competitors in the manufacture of such transmitters. Chamberlain's garage door openers contain a computer program that interprets a string of bits, called a "rolling code," received from a handheld transmitter. The rolling code changes each time the transmitter's button is pressed, and the program in the garage door opener activates the motor that opens the door only if the rolling code received from the transmitter satisfies a set of criteria generated by an algorithm. According to Chamberlain, the algorithm was designed to thwart potential burglars who would capture the string as it was emitted from a transmitter and would later replay it to open the door. Skylink's transmitters worked by doing an end run around the algorithm implemented in Chamberlain's computer code. The transmitters emitted a sequence of signals that Chamberlain intended to be used only to reset the algorithm. Chamberlain argued that Skylink's transmitter was a device designed for the purpose of circumventing the rolling code, which effectively controlled access to the computer program, and therefore violated section 1201(a)(2), the ban on trafficking in devices that circumvent access controls.

The appellate court upheld the district court's grant of summary judgment to Skylink.[91] The court held that for there to be a violation of the ban on trafficking in devices that circumvent access controls, the accused device must be one that circumvents access in a manner that results in infringement of a right protected by the Copyright Act.[92] Moreover, the court held that there can be no violation of the antitrafficking provision in the absence of an act that circumvents an access control.[93] In other words, not just any breach of an access control triggers liability under section 1201(a)(2): there must be a breach that results in infringement.[94]

In adopting this narrow reading of the trafficking ban, the court was self-consciously avoiding an alternative interpretation

---

[91] *Id.* at 1204.

[92] *Id.*

[93] *Id.* at 1196 n.13 ("For obvious reasons, § 1201(a)(2) trafficking liability cannot exist in the absence of § 1201(a)(1) violations . . . .").

[94] *Id.* at 1203.

that it feared would open the door to widespread use of section 1201 to suppress competition:

> Chamberlain's proposed construction would allow any manufacturer of any product to add a single copyrighted sentence or software fragment to its product, wrap the copyrighted material in a trivial "encryption" scheme, and thereby gain the right to restrict consumers' rights to use its products in conjunction with competing products. In other words, Chamberlain's construction of the DMCA would allow virtually any company to attempt to leverage its sales into aftermarket monopolies . . .[95]

The court's interpretation of section 1201 thus recognized its potential use as a tool to suppress competition, and the court sought to avert that outcome by means of a narrowing construction.

It remains to be seen, however, whether this narrow construction of section 1201 will have staying power. Neither the requirement that the breach of an access control result in actual infringement nor the rule that there can be no violation of the trafficking ban absent an act of circumvention appears on the face of the statute. Furthermore, if section 1201(a)(2) applies only to devices whose use results in infringement of a copyright owner's exclusive rights, that provision would seem to be redundant with the section 1201(b) ban on trafficking in devices that circumvent "protection afforded by a technological measure that effectively protects a right of a copyright owner."[96]

The *Lexmark* and *Chamberlain* decisions indicate that at least some courts are reluctant to allow section 1201 to be used to suppress competition in manufactured goods. However, it is too early in the judicial construction of section 1201 to feel any confidence that other courts will adopt the same viewpoint or that manufacturers will not devise other methods of incorporating copyrighted code or text into their products that will satisfy even a narrow construction of section 1201.[97]

### *D. Privacy*

TPMs can be implemented in ways that invade the privacy of

---

[95] *Id.* at 1201 (footnote omitted).

[96] 17 U.S.C. § 1201(b)(1)(A)-(C) (2000).

[97] For further discussion of the contexts in which TPMs might be used to suppress competition, see ELKIN-KOREN & SALZBERGER, *supra* note 77, at 42-43; Dan L. Burk, *Anticircumvention Misuse*, 50 UCLA L. REV. 1095, 1110-14 (2003).

users of the protected content.[98] This may come about when a publisher requires the user to divulge personal information before the publisher will grant access to content protected by a TPM.[99] Some TPMs are implemented using a globally unique identifier, which permits publishers to track users' preferences; publishers may find this information useful as a means of implementing price discrimination.[100] Copyright management information systems, an adjunct to TPMs, enable publishers to keep tabs on who is viewing their material.[101]

### *E. Implications of the Multifaceted Impact of TPMs*

As the above discussion indicates, legally backed TPMs have both positive and negative impacts on society. To the extent that they encourage publishers to make works available in digital formats, TPMs advance one of the fundamental goals of copyright by promoting access to creative output. On the other hand, TPMs impose costs on society to the extent that they entail contraction of the public domain, elimination of the secondary market, interference with competition, and intrusion on privacy.

Since TPMs are a mixed blessing, the optimal level of their deployment, from society's standpoint, is probably something

---

[98] *See* Julie E. Cohen, *DRM and Privacy*, 18 BERKELEY TECH. L.J. 575 (2003) (describing how TPMs can interfere with "intellectual privacy").

[99] *See* Julie E. Cohen, *A Right to Read Anonymously: A Closer Look at "Copyright Management" in Cyberspace*, 28 CONN. L. REV. 981, 985 (1996) (describing the potential use of TPMs for "profiling"); Comments of the Electronic Privacy Information Center, *In the Matter of Digital Entertainment and Rights Management, Before the Technology Administration, Department of Commerce,* July 17, 2002, http://www.epic.org/privacy/drmtadrmcomments7.17.02.html ("In an attempt to secure content, many DRM systems require the user to identify and authenticate a right of access to the protected media."). A working party of the European Union has recognized that collection of information via a digital rights management system implicates privacy interests that the EU's Data Privacy Directive protects. DATA PROTECTION WORKING PARTY, EUROPEAN COMMISSION DIRECTORATE-GENERAL FOR JUSTICE, FREEDOM, AND SECURITY, WORKING DOCUMENT ON DATA PROTECTION ISSUES RELATED TO INTELLECTUAL PROPERTY RIGHTS (Jan. 18, 2005), *available at* http://europa.eu.int/comm/justice_home/fsj/privacy/workinggroup/wpdocs/2005_en.htm.

[100] *See* Jonathan Weinberg, *Hardware-Based ID, Rights Management, and Trusted Systems*, 52 STAN. L. REV. 1251, 1269 (2000) (characterizing TPMs using hardware-based identifiers as "pernicious from a privacy perspective"). On price discrimination, see *supra* text accompanying note 66.

[101] *See* Pamela Samuelson, *The Copyright Grab*, WIRED, Jan. 1996, at 135 (describing systems that "have the ability to secretly report back to the copyright owner via the network on what the user was doing with the work, and the ability to search the consumer's hard disk and report back on what else was there").

less than the use of every available TPM on every copy of an information good. It is therefore worthwhile to inquire into the determinants of the efficacy of market forces in controlling the use of TPMs.

## IV

## Modeling the Behavior of Publishers in the Market for TPMs

Markets can do a very good job of optimizing the production of goods and services, enabling the expression of consumer preferences to bring about an economically efficient allocation of resources. It is often convenient to regard the *efficient* level of production of a particular good as the *correct* level; indeed, efficiency is often regarded as the sole criterion for assessing a particular deployment of society's resources.

To assess the efficacy of consumer preferences in disciplining publishers' implementation of TPMs under various market conditions, we need to model how a rational publisher determines *whether* to incorporate TPMs in a particular information good and, if TPMs are used, *what type* of TPM to implement. The standard tools of economic analysis are available for this purpose. Neoclassical economics posits that a rational producer's pricing and output decisions will depend on a set of factors, including the number of sellers and buyers in a market, the substitutability of different goods, the existence of barriers to entry, economies and diseconomies of scale, collusion among competitors, the information possessed by market participants, the magnitude of transaction costs, and the presence of externalities.

Since the addition of a TPM to an information good makes that product less desirable to buyers, it is tempting to model the addition of a TPM as the equivalent of a price increase. Use of such a model would be a mistake, however, for it overlooks two important distinctions between the two actions.

First, not all buyers consider the presence of a TPM to be an undesirable feature. The user of a music CD who does not care to make a copy for use in a car CD player or to give to a friend and who does not plan to extract tracks to make a mix CD would not value the CD any less if an anti-copy measure were added. A user of DVDs who does not travel overseas may not care in the least about region coding. If the TPM consists of a tethering restriction, a consumer who has no interest in using the copy on

more than one device will not consider the restriction to be a detriment. Indeed, many buyers may not even be aware that a particular information good incorporates a TPM. By contrast, economic analysis assumes that all rational consumers dislike a price increase and that all prospective purchasers have a reservation price. Under this assumption, any price increase will alienate the marginal purchaser. By contrast, the addition of TPMs will not necessarily have that effect. Within a particular range of TPM deployment, demand may be completely insensitive to the presence of TPMs.

Second, the addition of a TPM can either increase or decrease the demand for the product to which it is applied. The application of a TPM results in two offsetting effects. On the one hand, the TPM reduces the incidence of unauthorized use of the product, and to that extent, the TPM brings about increased demand for the product. If an anti-copy measure prevents a buyer from making a copy and giving it to a friend, or if a tethering measure prevents a buyer from disposing of a copy in the secondary market, the producer may make an additional sale.[102] On the other hand, adding a TPM has a negative effect on sales by causing some potential buyers—not all of them, since, as noted above, some buyers are indifferent to the presence of a TPM—to defect to a substitute product not burdened by a TPM. The TPM's net effect on the demand for the product is the difference between these two effects. By contrast, the effect of a price increase is unambiguously to depress demand.[103]

Nor can the addition of a TPM be accurately modeled as a reduction in product quality. First, a producer's reduction of the quality of its product usually has the effect of lowering manufac-

---

[102] Of course, not all suppressed copying translates into additional sales. Many, perhaps most, consumers who jump at the opportunity to enjoy an information good for free would not, if denied that opportunity, stand in line to pay full price for it. In a highly contested policy area—the impact of peer-to-peer sharing of music files—one study found that only ten to twenty percent of file downloads result in a lost sale, while another concluded that file sharing had no effect at all on sales. *See* Daniel Gross, *Does a Free Download Equal a Lost Sale?*, N.Y. TIMES, Nov. 21, 2004, § 3, at 4. *See also* WORKING PARTY ON THE INFORMATION ECONOMY, ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, DIGITAL BROADBAND CONTENT: MUSIC 78 (June 8, 2005), *available at* http://www.oecd.org/dataoecd/13/2/34995041.pdf ("It is very difficult to establish a basis to prove a causal relationship between the size of the drop in music sales (*i.e.* the size of the downloading-induced sales displacement) and the rise of file sharing . . . .").

[103] This is true for "ordinary goods," but not for the rarely encountered (except in economics textbooks) "Giffen goods." *See* VARIAN, *supra* note 68, at 104-05.

turing costs through substitution of cheaper materials or a cheaper manufacturing process.[104] By contrast, the addition of a TPM results in an *increase* in the cost of production. It costs money to develop or acquire the rights to a TPM technology, and it may cost money to incorporate that measure into the product. TPMs also generate consumer complaints, which cost money to deal with.[105] Implementing a product-activation TPM requires the publisher to maintain server-side systems to generate the unique code number that prevents the software from being installed on another machine. Second, a reduction in product quality shifts the demand curve to the left.[106] But, as explained above, the addition of a TPM may shift the demand curve in either direction or not at all.

The addition of TPMs thus generates tradeoffs for the publisher that differ from those facing a typical producer of goods that is considering a quality decrease. The ordinary producer must weigh the benefit of reduced costs against the detriment of reduced demand. The publisher, on the other hand, weighs the detriment of increased costs against an ambiguous effect on demand.

---

[104] It is conceivable that a producer might find it expedient to accept increased manufacturing costs in combination with reduced product quality, as the condition of receiving the benefits of planned obsolescence.

[105] *See* Julie A. Mark, Note, *Software Copying Policies: The Next Step in Piracy Prevention?*, 2 J.L. & TECH. 43, 45 (1987) ("An executive at one company estimated that by eliminating hardware protection publishers could save five million dollars per year in reduced support costs while increasing customer goodwill and eliminating copy protection fees."); Paul B. Carroll, *On Your Honor: Software Firms Remove Copy-Protection Devices*, WALL ST. J., Sept. 25, 1986, at 33 (reporting that in the mid-1980s, one software industry representative stated that "20% to 25% of the industry's service calls are related to problems caused by copy protection").

[106] This is true in the short term, but in the longer term, things get more complicated. If the product is durable and a secondary market exists, lowering product quality may have offsetting effects on demand. Reducing quality lowers demand, both because the product becomes intrinsically less desirable and because its resale value is reduced. On the other hand, a lower-quality product may wear out faster, with the result that fewer items will make it to the secondary market. This will tend to increase demand for the new items. For an analysis of a firm's output and pricing decisions with respect to durable goods that takes the secondary market into account, see DENNIS W. CARLTON & JEFFREY M. PERLOFF, MODERN INDUSTRIAL ORGANIZATION 476-97 (3d ed. 2000). The existence of items on the secondary market that are very durable and can be sold and resold many times can have a significant effect on the market for new items. *See* OZ SHY, INDUSTRIAL ORGANIZATION: THEORY AND APPLICATIONS 377 (1995) (noting that availability of light aircraft on the secondary market so reduced demand for new aircraft that several manufacturers stopped producing them).

Therefore, in modeling the effect that the addition of TPMs has on publishers and consumers, we must start from scratch. I make the following assumptions:

The TPMs incorporated into an information good can be quantified according to some metric. That metric, which for present purposes need not be specified, must indicate how restrictive the TPM is perceived to be by users of the information good.[107]

Potential users have a range of preferences concerning the incorporation of TPMs into an information good. For some users, addition of TPMs reduces the utility of the good, and different types of TPMs have different effects on the utility the user experiences. Other users are indifferent to the presence of TPMs, either entirely or within some range.

Publishers will incorporate into their products the quantity of TPMs that they expect will maximize their profits.

A publisher's optimization calculation depends on three components: (1) the quantity of sales lost due to the implementation of a TPM through alienation of existing customers, which I refer to as "alienated demand" or "AD";[108] (2) the quantity of additional sales made to those who had previously been making uncompensated use of copies owned by others but who can no longer do so because of the implementation of a TPM, which I call "recovered demand" or "RD";[109] and (3) the cost to the pub-

[107] The plausibility of the existence of such a metric is easiest to establish in connection with different versions of a particular TPM. For example, a TPM that allows an MP3 file to be played on three devices constitutes a larger "quantity" of technological protection than one that imposes a limit of five devices. To arrange different types of TPMs along a quantitative scale, we could imagine a shadow market in which consumers bid for different versions of an information good that are encumbered with different combinations of TPMs. The metric orders the TPMs according to the size of the bids they draw.

[108] Implementing TPMs might result in loss of demand not only from existing customers but also from prospective new customers. The idea is that one who is not a customer might be exposed to an information good through an unauthorized copy or distribution and might, as a result, become a paying customer. One such example is when a person becomes acquainted with new music through an unauthorized download of an MP3 file and then buys a CD of that music. Another example is when a person becomes dependent on a software application through using an unauthorized copy and then finds it worthwhile to gain access to an authorized copy for the technical support or to have the most recent version. For simplicity, we may incorporate this effect into the AD curve.

[109] Implementing TPMs might also benefit the publisher through entirely different mechanisms. As discussed above in Part III.C, one potential effect of TPMs is to lessen competition in a market other than the one for the information good that the TPM is designed to protect. Furthermore, as discussed above in Part III.B, TPMs may facilitate price discrimination, enabling the publisher to appropriate more of

lisher of implementing the TPM.

The model assumes a status quo in Period 0 in which the publisher does not implement TPMs. In Period 0, the publisher's profit is a function of the quantity the publisher sells, the price per unit it receives, and its costs:

$$\Pi = \Pi(q,p,c).$$

Its profit in Period 0 is thus

$$\Pi_0 = \Pi(q_0,p,c_0).^{110}$$

In Period 1, the publisher adds TPMs to the product, which has several effects. First, the use of TPMs changes demand by

$$\Delta D = RD(q_{tpm}) - AD(q_{tpm}),$$

where $q_{tpm}$ is the quantity of TPMs that the publisher chooses to implement, RD is the recovered demand, and AD is the alienated demand. Second, the use of TPMs increases the publisher's costs by

$$\Delta C = C(q_{tpm}),$$

where $C(q_{tpm})$ is the cost to the publisher of implementing a given quantity of TPMs. Since profit is revenue minus costs, the addition of TPMs changes profit by

$$\Delta\Pi = p\Delta D - C(q_{tpm}).$$

Profit in Period 1 is thus

$$\Pi_1 = \Pi_0 + \Delta\Pi = \Pi_0 + p\Delta D - C(q_{tpm}).$$

To determine the quantity of TPMs that maximizes $\Pi_1$, we set $\Pi'_1 = 0$. Then, we have

---

the surplus. To the extent that these effects exist, the publisher's incentive to implement the TPM is increased beyond the TPM's effect of increasing RD. For simplicity, we may incorporate this effect into the RD curve.

[110] To simplify matters, I assume that price remains constant from Period 0 to Period 1. This will not necessarily be the case. If implementing TPMs causes demand to rise, the publisher's average cost per unit may fall to the extent that economies of scale outweigh the costs of adding TPMs. In that case, the publisher could lower its price and thereby capture additional consumers from the margin. On the other hand, the publisher could maintain its price and make a larger profit per unit. This pricing decision will depend on elasticity of demand and on a variety of other factors that are extrinsic to the model.

$$\frac{d(\Pi_0 + p\Delta D)}{dq_{tpm}} = \frac{dC(q_{tpm})}{dq_{tpm}}.$$

In taking the derivative, $\Pi_0$ drops out since it does not vary with $q_{tpm}$. Since

$$\frac{d(p\Delta D)}{dq_{tpm}}$$

is just marginal revenue and

$$\frac{dC(q_{tpm})}{dq_{tpm}}$$

is just marginal cost, the optimization condition is

$$MR(q_{tpm}) = MC(q_{tpm}).$$

This is strongly reminiscent of the optimization condition that standard economic analysis applies in deriving the output decisions of firms in competitive and monopolistic markets. But there is an important difference. The variable here is the quantity of TPMs that the publisher chooses to deploy, not (as is usual in such analyses) the price or output quantity. Thus, in the present context, "marginal revenue" measures how revenue changes as the quantity of TPMs is varied, rather than how revenue changes as the price or quantity of the product is varied.

We can most easily understand how changing the quantity of TPMs affects a publisher's marginal revenue and marginal cost by using a graphical representation. Figure 1 shows how adding a given quantity of TPMs to an information good affects the demand for that good. The vertical axis plots the quantity of TPMs incorporated in the product, and the horizontal axis shows the quantity of the product demanded. The curve **AD** shows how the demand of existing authorized users for the product changes as TPMs are added to the product in increasing quantities. The intersection of curve **AD** with the horizontal axis shows the quantity demanded when no TPM is used. Moving along this curve upward and to the left, TPMs are introduced to the product in increasing quantity, causing increasing numbers of users to defect and therefore depressing demand. At its left end, curve **AD** may turn vertical before reaching the vertical axis if all remaining users are indifferent to the addition of more TPMs, or it

may intersect the vertical axis if the TPMs become so onerous that all existing users defect.

Curve **RD** shows the additional sales of the product that are made to consumers who, in the absence of TPMs, had used a copy owned by another consumer. Its beginning at the origin indicates the status quo. At its top end, curve **RD** turns vertical as use of industrial-strength TPMs has flushed out all potential buyers.[111]

Curve **NCD** ("net change in demand") is the horizontal summation of curves **AD** and **RD**. It shows the combined effect of the *reduction* in demand resulting from defections by existing users and the *increase* in demand resulting from conversion of would-be sharers, now thwarted by the presence of TPMs, into paying customers.

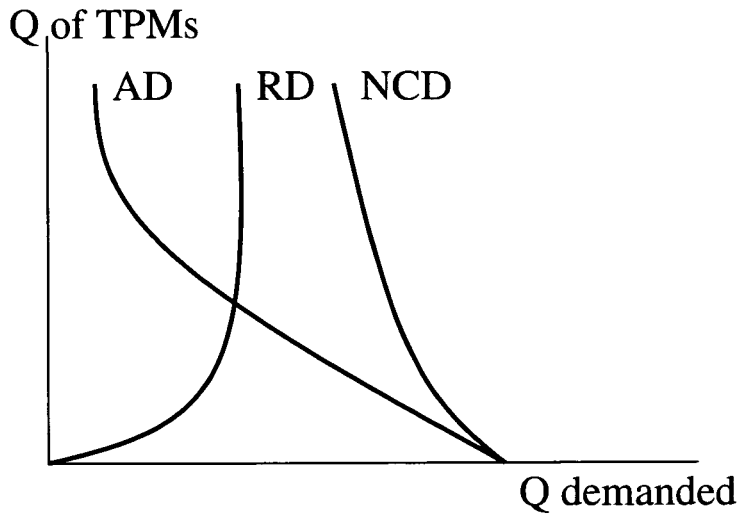


Figure 1

As depicted in Figure 1, curve **NCD** intersects **AD** at the horizontal axis and slopes upward to the left, indicating that the net effect of adding TPMs is a reduction in demand. This, however,

[111] It is possible that at high levels of TPMs, the RD curve will go past vertical and take on a negative slope, angling back toward the vertical axis. This would occur if adding TPMs becomes counterproductive because some potential buyers who were induced to buy at lower levels of TPMs become alienated and defect at higher levels. To simplify the analysis, I assume that the slope of the RD curve remains non-negative within the range of TPMs applied.

is not the inevitable shape of curve **NCD**. This shape results from unstated assumptions incorporated into the shapes of curves **AD** and **RD**. In particular, **AD** is drawn leaning more to the left than **RD** leans to the right, indicating that the addition of TPMs alienates more existing buyers than it attracts new buyers.

Figure 2 diagrams the opposite assumption. Curve **RD** remains unchanged from Figure 1, but curve **AD** is drawn more closely vertical, indicating that existing users are bothered only slightly by the addition of TPMs. As a result, summing these two curves yields a curve **NCD** that slopes upward and to the *right*, indicating that the addition of TPMs has had a net *positive* effect on demand. It is likewise possible to vary the shape of curve **RD**. We can move the top end closer to the vertical axis, reflecting an assumption that the TPMs are less effective in turning unauthorized users into authorized users.

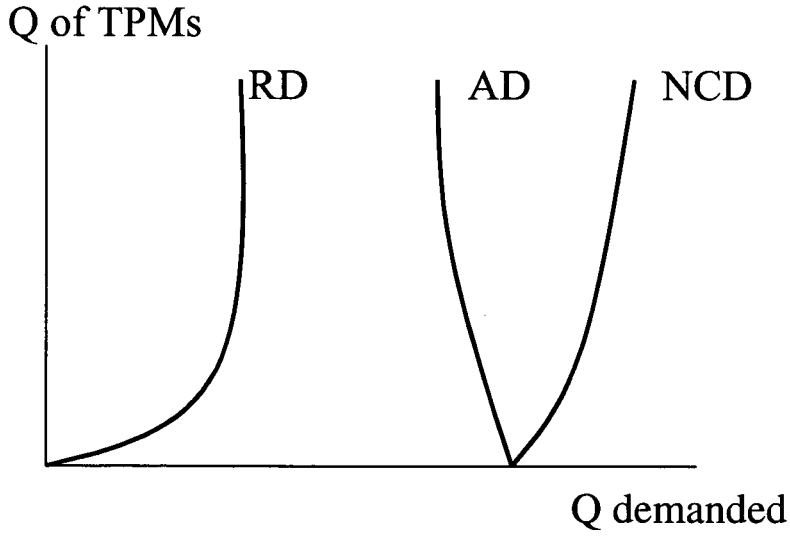


Figure 2

By varying our assumptions about consumer preferences and the effectiveness of TPMs in suppressing unauthorized use, we can generate a family of plausible **AD** curves and another of **RD** curves. Figure 3 shows the former; Figure 4, the latter.

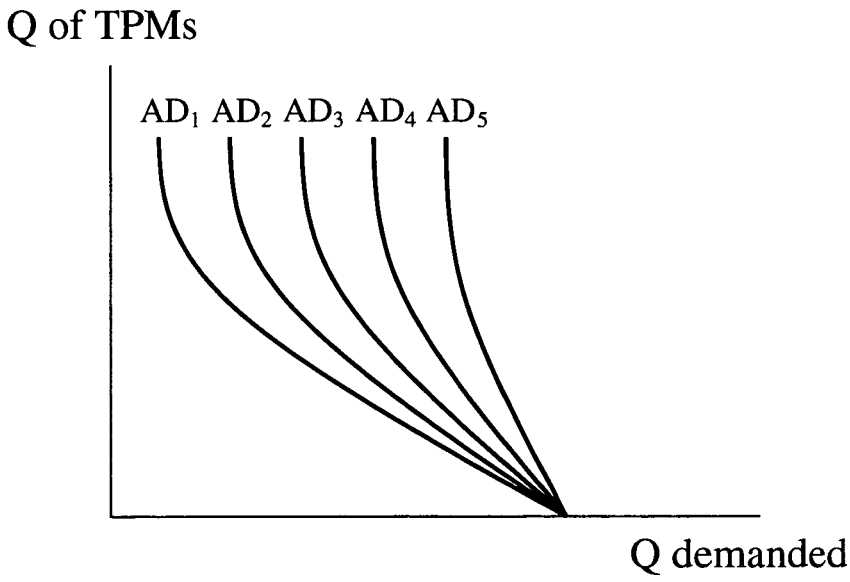


Figure 3

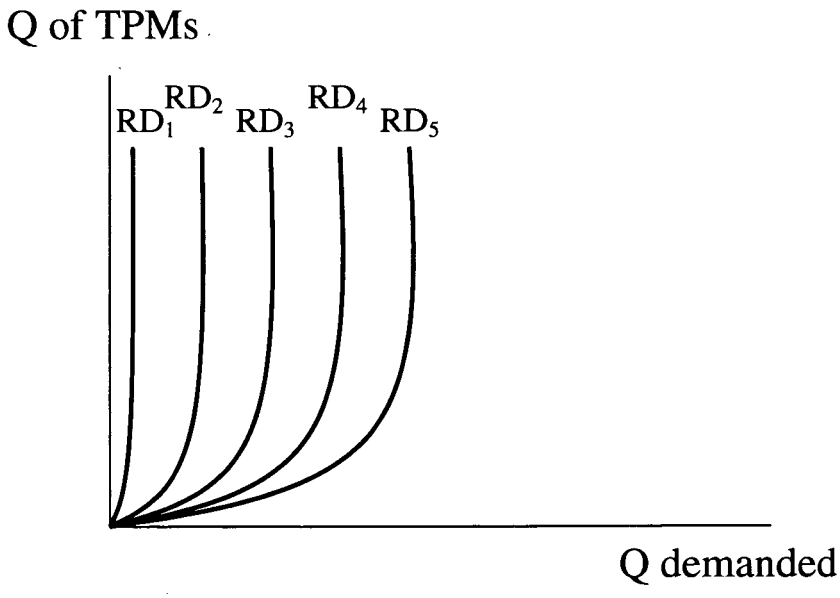


Figure 4

By mixing and matching these $\mathbf{AD_i}$ and $\mathbf{RD_i}$ curves, we get a family of corresponding $\mathbf{NCD_i}$ curves, as shown in Figure 5.

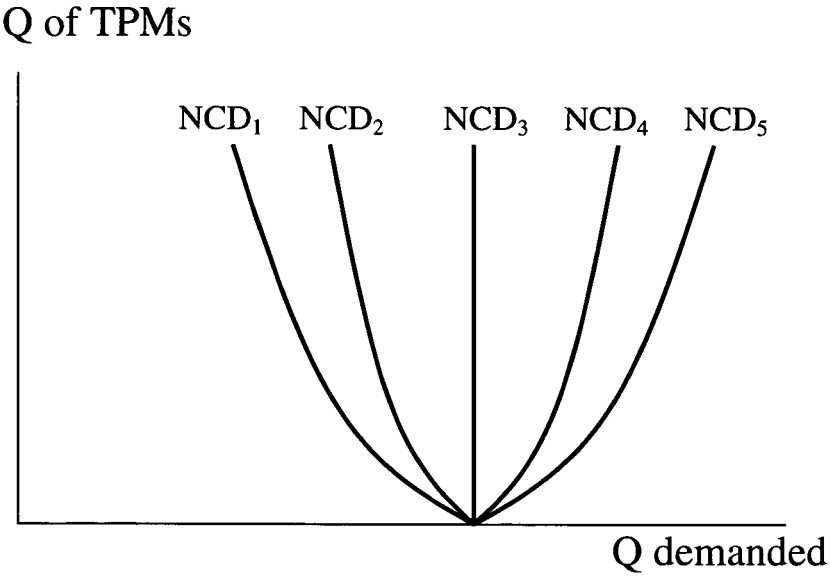


Figure 5

For example, curve $\mathbf{NCD_1}$ would result from combining $\mathbf{RD_1}$ with $\mathbf{AD_1}$, curve $\mathbf{NCD_5}$ would result from combining $\mathbf{RD_5}$ with $\mathbf{AD_5}$, etc.

The possibility that there are NCD curves shaped like $\mathbf{NCD_4}$ and $\mathbf{NCD_5}$ demonstrates why the addition of TPMs cannot realistically be modeled as a price increase. These curves represent upward-sloping demand curves—a species not observed in the neoclassical world of microeconomic theory.[112]

The RD curve resulting from a particular TPM may not be independent of the AD curve associated with the same product-TPM combination. It might be, for example, that current users of an information good dislike a TPM just to the extent that it is effective in reducing unauthorized use. If so, we would expect that a product-TPM combination with an AD curve like $\mathbf{AD_1}$ would have an RD curve like $\mathbf{RD_5}$. To the extent that there is such a correlation, we would not expect to find combinations like

[112] Recall, however, that these curves model demand as a function of quantity of TPMs rather than as a function of price. Therefore, the unusual shape of these curves does not contradict any of the assumptions of neoclassical economics.

**$RD_5$** with **$AD_5$** or **$RD_1$** with **$AD_1$**. As a result, the family of NCD curves would be clustered around the **$NCD_3$** curve rather than deviating outward like the **$NCD_1$** and **$NCD_5$** curves. On the other hand, a TPM that is very effective at preventing unauthorized use and that is designed so as to annoy as few current users as possible might well result in a combination of curves like **$RD_5$** with **$AD_5$**, resulting in an outcome like **$NCD_5$**.

The next step in the analysis is to derive the marginal revenue curve associated with each product-TPM combination. In economic analysis, it is common for a marginal revenue curve to show the change in revenue resulting from a change in *price or output* of a product. In the current context, as noted above, we are interested in how revenue changes in response to a change in the *quantity of TPMs* incorporated into the product. The marginal revenue curve is derived from the demand curve; it is the slope of the demand curve at each point.[113] Since we have a family of NCD curves, we will correspondingly have a family of MR curves, as shown in Figure 6.

In this graph, the axes have been reconfigured: the horizontal axis plots the quantity of TPMs, and the vertical axis shows the marginal revenue associated with the quantity of each TPM. Marginal revenue curve **$MR_5$** corresponds to demand curve **$NCD_5$**. Curve **$MR_5$** intersects the vertical axis at a positive value, corresponding to the fact that **$NCD_5$** shows demand rising as the quantity of TPMs increases. **$MR_5$** is a decreasing function since **$NCD_5$** becomes continually steeper, showing decreasing returns to the addition of more TPMs. **$MR_5$** intersects the horizontal axis at the point (that is, the quantity of TPMs) where **$NCD_5$** turns vertical, meaning that adding more TPMs yields no further revenue increase.

Analogously, curve **$MR_1$** corresponds to demand curve **$NCD_1$**. Since **$NCD_1$** shows the quantity demanded decreasing as TPMs are added, **$MR_1$** remains in negative territory until it intersects the horizontal axis at the point where **$NCD_1$** turns vertical. Curve **$MR_3$**, corresponding to **$NCD_3$**, is depicted at a constant

---

[113] Marginal revenue is actually the slope of the total revenue curve; that is, it represents the rate at which total revenue changes. *See* B. CURTIS EATON & DIANE F. EATON, MICROECONOMICS 288 (2d ed. 1991). In the scenario under consideration, price is constant. Since total revenue equals price times demand, the slope of the total revenue curve is the same as the slope of the demand curve.

value of zero since the verticality of $\mathbf{NCD_3}$ shows that the quantity demanded is insensitive to the quantity of TPMs.

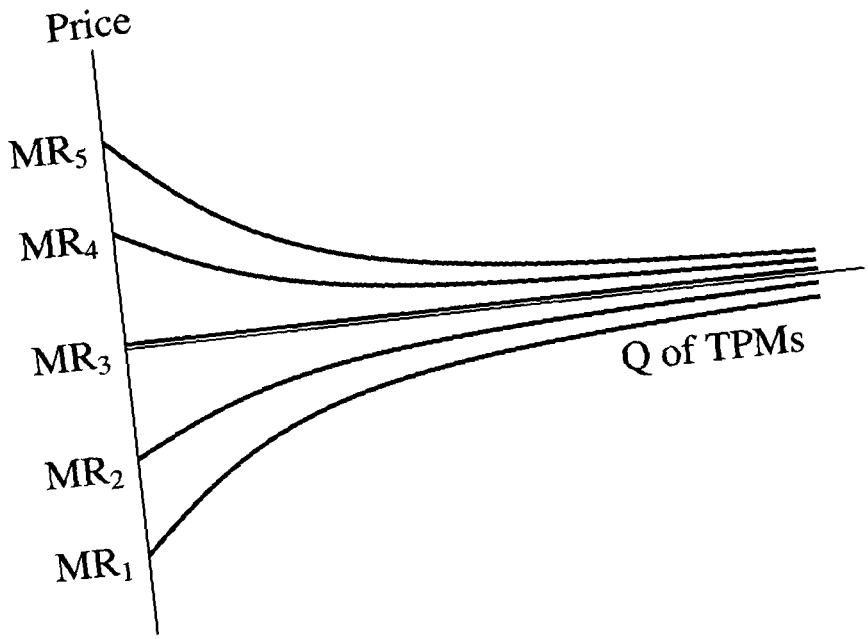


Figure 6

Now that we have the family of marginal revenue curves, we may proceed to the question of marginal cost. The standard economic analysis of the output decision of a firm in a competitive market, illustrated in Figure 7, posits that the producer will increase output until the marginal cost of producing an additional unit equals the price at which it can be sold, which is marginal revenue.[114]

[114] *See* EATON & EATON, *supra* note 113, at 262 (stating that a profit-maximizing firm in a competitive market will "[p]roduce the level of output at which marginal revenue (or price) is equal to marginal cost").

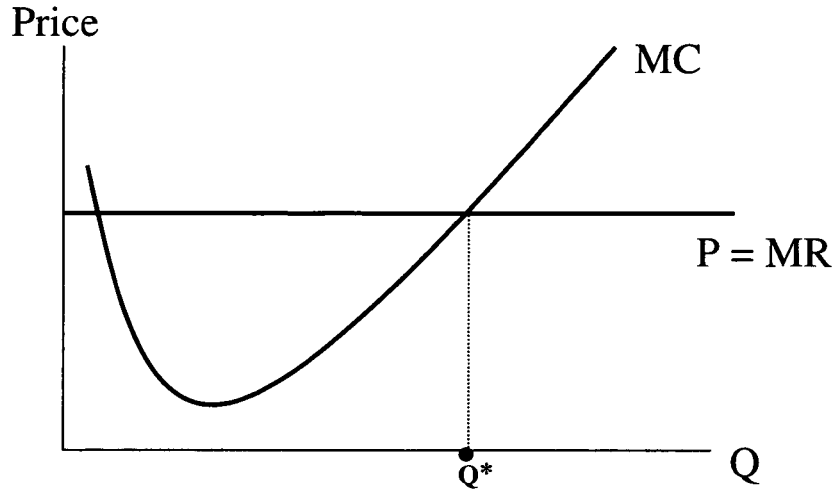


Figure 7

A firm's marginal cost curve is typically depicted as U-shaped. That shape is attributable to the presumed effects of scale economies: initial increases in output bring increasing returns to scale as the firm is able to dispose of productive resources more efficiently, while further increases in output bring decreasing returns as it becomes necessary to substitute higher-cost inputs. Figure 7 depicts the standard determination of the profit-maximizing output of a firm in a competitive market, which occurs at the quantity **q*** where marginal cost equals price.

This standard depiction of a marginal cost curve cannot be imported into the present context, due to a crucial difference between the two situations. In the standard analysis, cost is graphed against the *quantity of output of a good*; scale economies and diseconomies result from variations in the costs of the relevant inputs. Here, we graph cost against the *quantity of TPMs incorporated in each exemplar of the good*. Instead of producing fewer or more exemplars, the publisher is incorporating a greater or lesser quantity of TPMs into each exemplar.

Thus, it is not at all clear what shape to assign to the curve depicting a publisher's marginal cost of adding TPMs to the good. We must assume that the rational publisher will first deploy the TPM that yields the greatest bang for the buck. Formally, the publisher will first deploy the TPM that maximizes *?MR – C*, where C represents the cost of implementing the

TPM.[115] The TPM that maximizes this value will not necessarily be the one that is least expensive for the publisher to use. It might be that a relatively expensive TPM is the most effective at thwarting would-be unauthorized users and is also designed to minimize the inconvenience that it creates for the user.

Therefore, the publisher's marginal cost curve can take a variety of shapes. All we can say for sure is that the curve always lies above the horizontal axis, since TPMs must cost something. If we overlay the range of MC curves on the family of MR curves shown in Figure 6, we can see the possible relationships between the MC and MR curves. The shaded rectangle in Figure 8 shows the region within which the MC curve may wander.

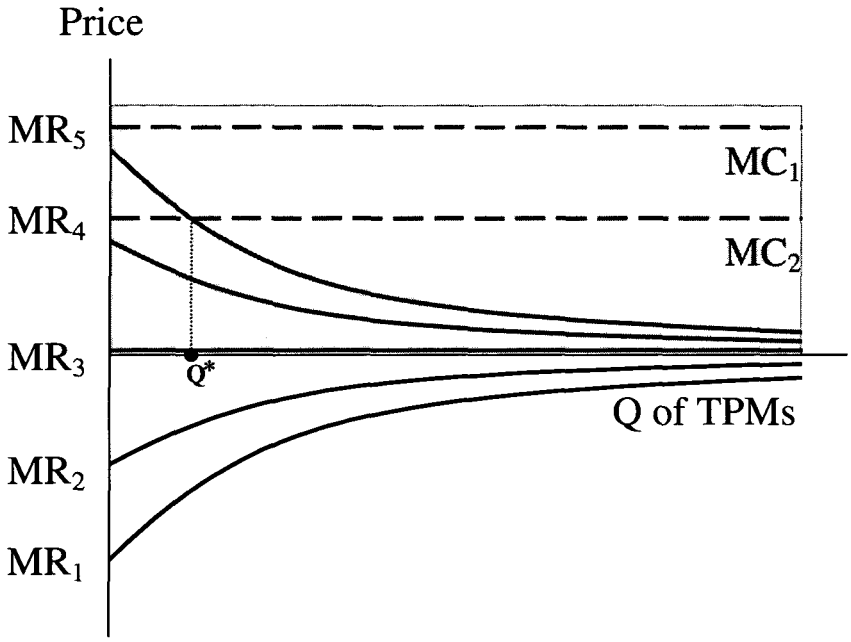


Figure 8

The two dashed lines show two types of relationships (among various other possibilities) that the MC curve may have with the MR curves. **$MC_1$** lies above the MR curves throughout its length. That means that there is no cost-effective TPM available. Every

[115] This assumes that $?MR > 0$. As we are about to see, if $?MR = 0$, the publisher will not implement any TPM.

available TPM costs more to implement than the marginal revenue it generates. If this is the case, the publisher will not use any TPMs. Curve $\mathbf{MC_2}$ lies above some of the MR curves but intersects others. Thus, if the MR curve applying to a particular product is $\mathbf{MR_5}$ and the applicable MC curve is $\mathbf{MC_2}$, then the publisher maximizes profits by implementing the quantity of TPMs indicated by point $\mathbf{q^*}$.[116] If, however, the applicable MR curve is $\mathbf{MR_4}$, no TPMs will be implemented.

Suppose the MR curve applying to the product is $\mathbf{MR_3}$, $\mathbf{MR_2}$, or $\mathbf{MR_1}$. In that case, no TPMs will be used no matter what the marginal cost since, by hypothesis, adding any level of TPMs will reduce total revenue.

We can now summarize our conclusions concerning the behavior of a publisher in determining what level of TPMs to incorporate into a particular product. The publisher will choose a level of TPMs such that marginal revenue with respect to the quantity of TPMs equals marginal cost of adding TPMs. The marginal revenue curve may assume a variety of shapes. If the relevant MR curve lies entirely below the horizontal axis, the publisher will maximize profits by using no TPMs. If the MR curve lies above the horizontal axis and the marginal cost curve intersects that MR curve, the publisher maximizes profits by adding some positive quantity of TPMs.

## V

## Application of the Model to Various Market Structures

Publishers of copyrighted materials have frequently been characterized as monopolists.[117] There is a kernel of truth to this characterization, but the full truth is more complicated.[118] No

---

[116] If the MC curve is not monotonic, it might intersect an MR curve at more than one point. This would make it more difficult to determine the level of TPMs that maximizes profits, for we would then have to compute the *total* cost of implementing TPMs and compare that to the *total* change in marginal revenue along the whole TPM axis. To avoid this complication, I will assume that the MC curve intersects the MR curve only at one point or that it is U-shaped and intersects at two points.

[117] *See, e.g.*, Sony Corp. v. Universal City Studios, Inc., 464 U.S. 417, 429 (1984) (referencing "the copyright monopoly granted by Congress"); Twentieth Century Music Corp. v. Aiken, 422 U.S. 151, 154 (1975) ("The Copyright Act . . . gives to a copyright holder a monopoly limited to specified 'exclusive' rights in his copyrighted works.").

[118] *See* Boyle, *supra* note 45, at 8 n.23 (discussing whether intellectual property rules create what is appropriately characterized as monopoly); Margaret Jane Radin,

single characterization can accurately describe the market for copyrighted goods as a whole. The market structure confronting a particular market participant with respect to a particular product will depend on factors such as how many other market participants offer similar products and whether other products in the market are close substitutes. Different sellers will face different market conditions: near-perfect (or at least robust) competition, monopolistic competition (which itself describes a range of market structures), oligopoly, and monopoly.

### *A. Competitive Markets*

Perfect competition in a particular market is defined with respect to a particular homogeneous good or a set of goods that consumers view as perfect substitutes for each other. The principal conditions that define a competitive market are as follows: (1) The number of buyers and sellers in the market is large enough that each is of insignificant size in comparison with the quantity of the good supplied in the market; (2) there are no barriers impeding entry to or exit from the market; (3) buyers and sellers possess all relevant information about the market; and (4) there are no externalities.[119]

Some segments of the market for information goods are relatively close to the ideal of perfect competition. The market for pornographic movies might be an example. There are many sellers of these movies, and there are also many buyers. We might reasonably posit that, for a large segment of the consuming public, one such movie is a close substitute for another. No doubt there are exceptional pornographic films that are more highly valued by consumers, for one reason or another. Such movies might define a separate market. Under these conditions, no individual seller of movies has any market power.[120] If one seller raises its price, it will experience a significant loss of sales as buyers choose other movies that are just as desirable and are also cheaper. If the market structure was truly one of perfect compe-

*Property Evolving in Cyberspace*, 15 J.L. & COM. 509, 518 (1996) ("Market power involves something more than exclusion rights, such as dominant market share with high barriers to entry.").

[119] *See* CARLTON & PERLOFF, *supra* note 106, at 57-58; SCHERER & ROSS, *supra* note 70, at 17-18.

[120] *See* CARLTON & PERLOFF, *supra* note 106, at 92 ("Whenever a firm can influence the price it receives for its product, the firm is said to have *monopoly power* or *market power*.").

tition, a seller that raised its price would see its sales drop to zero.

Another plausible example in the same mold is a recording of classical music by an undistinguished orchestra. Buyers may be willing to pay a higher price for a recording by a highly regarded orchestra or conductor, but other recordings will be viewed as generic and will be selected on the criterion of price alone. Other candidates include simple computer programs, generic landscape paintings, books of crossword puzzles, and Harlequin romance novels.

In addition to competition arising from such substitutive content, there may be competition due to substitutive formats. A movie publisher may offer a particular film in both DVD and VHS videotape formats, each incorporating a different type of TPM. A music publisher might offer a recording on CD, cassette tape, and digital audio tape. Although it may seem counterintuitive for a publisher to compete against itself in this way, multiple-format releases may make sense as a means of price discrimination or market segmentation. Economies of scale and network externalities may limit the impact of this sort of competition as newer technologies displace the old—movie rental stores increasingly stock more DVDs and fewer VHS tapes; record stores carry mostly CDs, a few cassettes, and no DAT or vinyl phonograph records—and diversity is replaced by monoculture.[121]

With the competitive market as the baseline, we can proceed to consider how a change in the market structure affects the responsiveness of publishers to consumer preferences in their decisions whether to implement TPMs.

### *B. Monopoly*

As observed above, there is a kernel of truth in the common characterization of copyright as conferring a monopoly on the copyright owner: copyright owners have a legal right to prevent anyone else from making available in the marketplace works that are identical or substantially similar to their own works.[122] The exclusive rights of the copyright owner constitute what may be called monopoly in common parlance, but more is required for

---

[121] On network externalities, see Michael L. Katz & Carl Shapiro, *Network Externalities, Competition, and Compatibility,* 75 AM. ECON. REV. 424 (1985).

[122] *See* Laureyssens v. Idea Group, Inc., 964 F.2d 131, 140 (2d Cir. 1992) (explaining that substantial similarity is the prerequisite for infringement).

there to be monopoly as economists use the term. For the economist, monopoly describes a situation in which a seller offers a product that has no close substitutes.[123] The lack of close substitutes gives the seller market power: it can raise price above marginal cost without seeing sales go to zero (as would occur in the case of pure competition). For a monopoly to exist more than momentarily, there must be barriers to entry that protect the monopolist from competitors offering similar products. But the monopolist is not entirely immune from consumer sovereignty. If the monopolist raises the price of its product, the quantity it is able to sell will decrease as some buyers forgo purchasing the product because the price exceeds the value they place on it. This is reflected in the downward-sloping demand curve that is conventionally used to model the behavior of monopolists.[124]

The absence of close substitutes means that the monopolist need not be as responsive to consumer preferences as a participant in a competitive market must be. If the monopolist raises its price marginally, it will lose those marginal customers whose valuation of the product is less than the increased price. But with a small price increase, the monopolist will not lose many customers to competitors. This result is true by definition, there being no close substitutes for the monopolist's product. The same reasoning holds true for product characteristics: minor reductions in the desirability of product characteristics will not cause the monopolist to lose many customers, but major quality reductions might have more of an effect.

Some publishers of information goods occupy a position that could reasonably be characterized as monopolistic.[125] Consider, for example, publishers of computer operating systems. An operating system has no close substitutes because the costs of switching to a different operating system, due to software and

---

123 *See* EATON & EATON, *supra* note 113, at 286 ("A firm is a monopoly if no other firm produces either the same good or a close substitute for it."). The legal definition of monopoly—the one that is relevant in assessing compliance with the Sherman Act—is a bit different. "Monopoly power" under the Sherman Act consists of "the power to control prices or exclude competition." United States v. E.I. du Pont de Nemours & Co., 351 U.S. 377, 391 (1956).

124 *See* CARLTON & PERLOFF, *supra* note 106, at 87 ("A monopoly faces a downward-sloping demand curve and sets a price above marginal cost.").

125 Whether a particular market participant is a monopolist is a contestable issue. *See* EATON & EATON, *supra* note 113, at 286 ("Th[e] definition of monopoly is unavoidably ambiguous because we can't define 'close substitute' with perfect precision.").

hardware incompatibilities and other switching costs, are very large.[126] Microsoft has been adjudged a monopolist in the market for Intel-compatible personal computers with respect to its Windows operating system,[127] and Apple is arguably just as much of a monopolist in the market for Macintosh-compatible operating systems. A seller of the Linux operating system, however, is not a monopolist: since Linux is an open-source product, anyone who wishes to sell it competitively is free to do so.

The publisher of a book that defines its own genre might be considered a monopolist.[128] Consider the (currently hypothetical) seventh book of the Harry Potter series. There are no close substitutes: no other book comes close to offering the conclusion of the story of Harry's epic struggle against the forces of evil. If the publisher raised the price of the book, the publisher would lose sales, but that is true of any monopolist. The only substitutes for purchasing the hardcover book involve waiting: bor-

---

[126] *See* United States v. Microsoft Corp., 253 F.3d 34, 52 (D.C. Cir. 2001) (en banc) (per curiam) (referencing the district court's finding that "consumers would not switch from Windows to Mac OS in response to a substantial price increase because of the costs of acquiring the new hardware needed to run Mac OS (an Apple computer and peripherals) and compatible software applications, as well as because of the effort involved in learning the new system and transferring files to its format.").

[127] *See id.* at 51-56.

[128] Similarly, monopoly status might also be attributed to one-of-a-kind movies, musical recordings, or works of art. But to say that a producer is a monopolist with respect to a particular product is not to say that the producer is violating the Sherman Act's proscription against monopolizing a market.

Some courts have been unreceptive to the idea that a single product may define a relevant market for purposes of antitrust analysis. *See* Theatre Party Assocs., Inc. v. Shubert Org., Inc., 695 F. Supp. 150, 155 (S.D.N.Y. 1988) ("It is well settled that a manufacturer's monopoly over the distribution of its own product cannot form the basis of a valid monopolization claim."); Lynch Bus. Machs., Inc. v. A.B. Dick Co., 594 F. Supp. 59, 66 (N.D. Ohio 1984) ("Monopoly power cannot be shown through a manufacturer's control of its own product, because a manufacturer cannot monopolize its own product."). Other courts have held that such a conclusion may be reached under exceptional circumstances. *See* Bushie v. Stenocord Corp., 460 F.2d 116, 121 (9th Cir. 1972) ("A single manufacturer's products might be found to comprise, by themselves, a relevant market for the purposes of a monopolization claim, if they are so unique or so dominant in the market in which they compete that any action by the manufacturer to increase his control over his product virtually assures that competition in the market will be destroyed."); Levitch v. Columbia Broad. Sys., Inc., 495 F. Supp. 649, 663 (S.D.N.Y. 1980) ("Thus, only when a manufacturer's product is so unique or so dominant in the market will this single product define the relevant market.").

In any event, however, it is clear that an information good may have no close substitutes, which is the factor that is relevant for purposes of our model of a publisher's decision whether to implement TPMs.

rowing the book from a library or a friend, buying the less-expensive paperback edition, buying a used copy, or maybe seeing the movie (which may not be a very close substitute). These are imperfect substitutes. The delay in gratification, the used condition or temporary availability of the book, the transaction costs incurred in locating a used book, etc., are all product characteristics that will make the substitute less desirable for some subset of potential buyers. The secondary market constrains the market power of the publisher, but it does so only to a limited extent.[129]

Under the standard analysis, a monopolist that is unable to engage in price discrimination will, in comparison to a competitive supplier, raise its price and reduce its output, and in so doing, it will realize monopoly rents while imposing a deadweight loss on society.[130] The analysis applied to monopolists fundamentally differs from that applied to pure competitors. Because each producer in a purely competitive market is a price taker, its profit-maximizing calculation depends only on the shape of its production function and involves finding an output level at which its marginal cost equals the product's price. But a monopolist can set its own price and so must consider both its production function and the shape of the demand curve that it faces.

The difference between the approach of a publisher in a monopolistic market and one in a competitive market in determining whether to implement TPMs is less marked than under the standard analysis. The fact that no close substitutes are available changes the shape of the relevant demand curves, but it does not change the basic analysis.

Let us go back to Figure 1 and consider the shape of the **AD** curve. Under competitive conditions, the introduction of TPMs causes a relatively rapid decrease in demand, as buyers who are

---

[129] In the *Alcoa* case, United States v. Aluminum Co. of Am., 148 F.2d 416, 425 (2d Cir. 1945), Judge Hand determined that the availability of scrap aluminum on the secondary market does not dilute the market power of Alcoa, the monopoly producer of new aluminum. Several economists have concluded that Hand's analysis was largely correct, as an empirical matter, with respect to the aluminum market. *See* Darius W. Gaskins, Jr., *Alcoa Revisited: The Welfare Implications of a Second-hand Market*, 7 J. ECON. THEORY 254 (1974); Peter L. Swan, *Alcoa: The Influence of Recycling on Monopoly Power*, 88 J. POL. ECON. 76 (1980). More generally, however, the existence of a secondary market does constrain a firm's market power to an extent that varies with market conditions. *See* Franklin M. Fisher, *Alcoa Revisited: Comment*, 9 J. ECON. THEORY 357 (1974).

[130] *See* CARLTON & PERLOFF, *supra* note 106, at 88-94.

sensitive to TPMs defect in favor of close substitutes. If the product has no close substitutes, we would expect a lower rate of defection. Just as a monopolist suffers less of a reduction in demand from a price increase than does a seller in a competitive market, the monopolist suffers less of a reduction in demand when it adds TPMs than does a pure competitor.

To test our intuition on this, we may consider the Windows operating system as the poster child of an information good with no close substitutes. Microsoft first implemented a tethering system, called "product activation," to control use of its Windows software when it released Windows XP in August 2001. Product activation usually proceeds transparently, but a user who changes the computer's hardware components or reformats the hard drive might experience the annoyance of having to reactivate Windows.[131] Some commentators predicted substantial consumer resistance to the new activation requirement,[132] but this does not seem to have materialized.[133] This outcome is hardly surprising: switching from Windows to the Mac OS or Linux requires the user to incur massive costs to purchase new software and (for Mac) hardware, to reinstall and reconfigure software applications, to learn how to use the new system, and so forth. Few Windows users dislike the tethering TPM enough to be willing to incur these expenses.

We should therefore expect that under monopoly, the **AD** curve in Figure 1 will veer less sharply to the left from its intersection with the horizontal axis in comparison to competitive

---

[131] *See* Microsoft, Windows XP Product Activation, Aug. 29, 2002, http://www.microsoft.com/windowsxp/evaluation/features/activation.mspx ("If you overhaul your computer by replacing a substantial number of hardware components, it may appear to be a different PC. You may have to reactivate Windows XP."). If you have arithmophobia, forget about it. *See* Lawrence J. Magid, *Tech 101 PC Focus: Yet Another Step to Start Windows XP*, L.A. TIMES, July 19, 2001, at T8 ("The software offered a toll-free number. I was kept on hold for five minutes and then connected to an operator who asked me to read a 50-digit code generated by the activation program. He typed it in his computer, which, in turn, generated a 42-digit code that he read to me as I typed.").

[132] *See* Jube Shiver Jr., *Microsoft Ships XP, Hoping to Revive Sales*, L.A. TIMES, Aug. 25, 2001, at C1 ("A poll of visitors to PCWorld.com, publisher of San Francisco-based PC World magazine, found 'a near-unanimous thumbs-down' to product activation. Experts say the feature could trigger a consumer backlash that would further dampen PC sales.").

[133] *See* Paul Thurrott, *OS Market Share: Microsoft Stomps the Competition*, WINDOWSIT PRO, Oct. 9, 2003, http://www.winnetmag.com/Article/ArticleID/40481/40481.html ("Windows desktop OS sales worldwide increased from 93.2 percent of the market in 2001 to 93.8 percent in 2002 . . . .").

conditions. The relationship between an **AD** curve under competition and one under monopoly, *ceteris paribus*, might look something like Figure 9: compare **AD** under competition (gray) with **AD'** under monopoly (black).

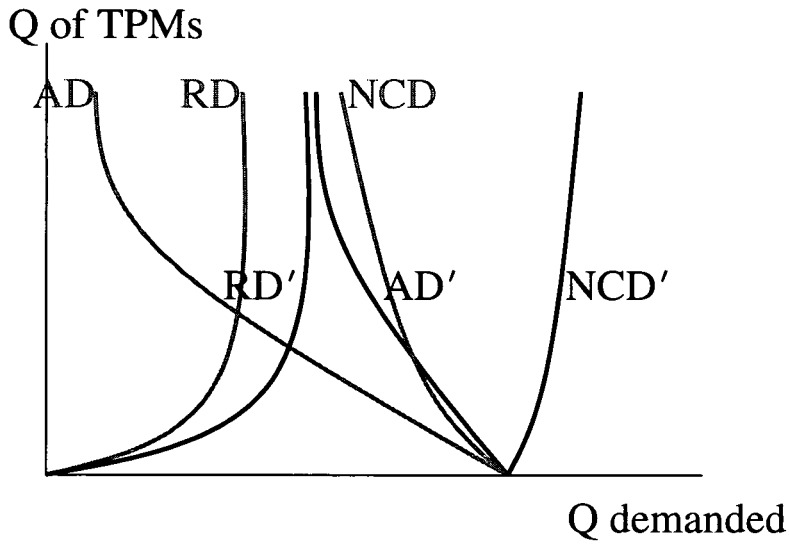


Figure 9

Now let us consider the shape of the **RD** curve under monopoly. The recovered demand consists of those users of the product who, without TPMs, had been able to satisfy their desire for the product through methods that do not result in compensation to the publisher (such as borrowing a copy from a friend or a library, obtaining an unauthorized copy, or buying a used copy on the secondary market) and whose demand for the product is sufficiently strong that they continue using it even after the publisher implements TPMs that require them to use it on the publisher's terms. In a competitive market, users who, due to the implementation of TPMs, are unable to continue making unauthorized use of the product have two options: they can pay the publisher for authorized use of the product, or they can switch to another product that is a close substitute and is not protected by TPMs. In a monopolistic market, the alternative to paying for use of the product is to switch to a product that is not a close substitute. Since switching to a close substitute is, by definition, less expensive than switching to a more distant substitute, we

should expect that switching will be more likely to occur in a competitive market.

Thus, a consumer who, due to the implementation of a tethering measure, can no longer borrow a certain brand of generic classical music recordings from a friend may well switch to borrowing another publisher's untethered recordings and will not contribute to the first publisher's recovered demand. But a consumer who has been in the habit of installing one copy of Windows on two computers and can no longer do so because of the product activation requirement will probably buy a second copy of Windows XP rather than switching to Linux, and this will increase Microsoft's recovered demand. Figure 9 depicts **RD** under competition (gray) and **RD'** under monopoly (black).

Since both the **AD** curve and the **RD** curve lean more to the right under monopolistic conditions than under competition, their horizontal summation, **NCD**, will likewise incline more to the right. Compare **NCD** under competition (gray) with **NCD'** under monopoly (black).

Following through the implications of this analysis, the family of **NCD** curves will incline further to the right under monopoly than under competition. Figure 10 shows the **NCD** curves under competition (gray) compared to the **NCD'** curves under monopoly (black). Finally, the associated **MR** curves will tend to shift upward, as shown in Figure 11 (depicting only the monopoly curves, $\mathbf{MR_i'}$). There is no reason to expect that the marginal cost of implementing TPMs will be higher under monopoly as compared to a competitive market. Therefore, the **MC** curve should intersect the applicable **MR** curve further to the right, leading the publisher to implement a larger quantity of TPMs under monopoly than under competition.

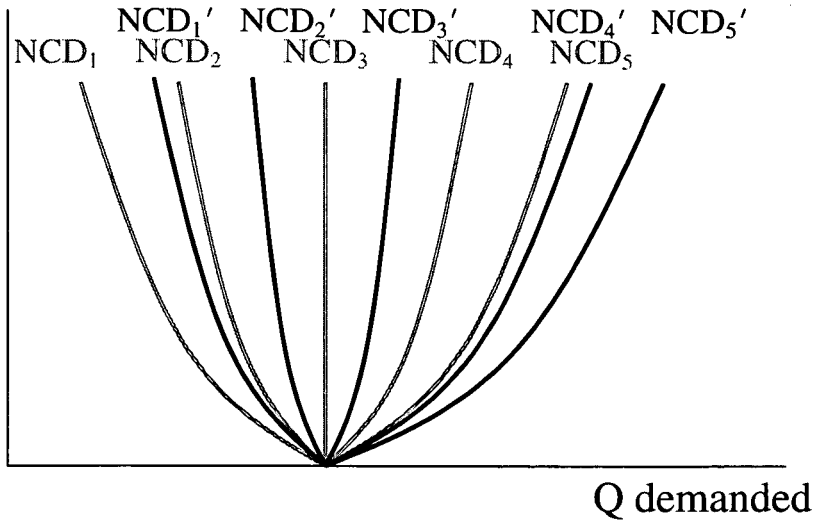


Figure 10

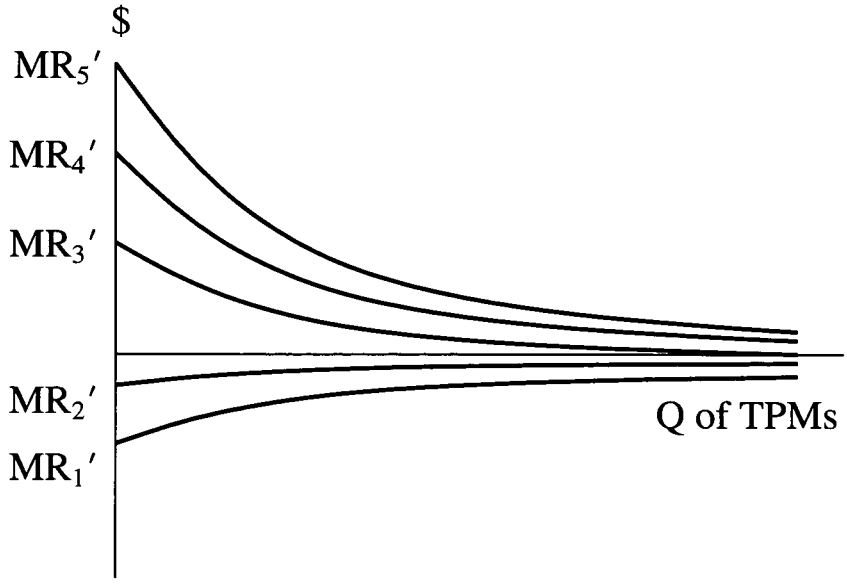


Figure 11

This does not mean, of course, that every publisher will implement TPMs in its products in markets where it holds a monopoly position. A monopolist, like any other producer, will only imple-

ment TPMs if the benefits that it expects to receive (additional sales due to reduced unauthorized use) exceed the costs that it expects to incur (lost sales due to alienating current customers and the costs of implementing TPMs). This analysis simply means that, all else being equal, a publisher is more likely to implement TPMs in a product to the extent that the product has no close substitutes. This result accords with the intuition that a monopolist can be less responsive to consumer preferences than can a seller in a competitive market.

This analysis also shows that the mechanics of a monopolist's calculation of what quantity of TPMs will maximize its profit do not differ from those of the competitor. The difference lies only in the shape of the relevant demand functions.

### *C. Monopolistic Competition*

Competitive markets and monopolized markets represent two extremes. Between these extremes lie various gradations of markets that can be usefully modeled as monopolistic competition.

In a market characterized by monopolistic competition, each seller is the sole supplier of a good that, while possessing unique characteristics, has fairly close substitutes in the market. Still, the substitute products are different enough from each other that sellers will have some market power. Unlike sellers in a perfectly competitive market, a monopolistic competitor can raise its price by some amount without its sales dropping to zero. However, the products are close enough substitutes that sellers cannot behave like monopolists: if a monopolistic competitor raises its price even modestly, some buyers will defect to the supplier of a substitute good. Thus, monopolistic competitors, like monopolists, face a downward-sloping demand curve rather than the horizontal curve faced by the seller in a competitive market, but the curve facing the monopolistic competitor is flatter (slope is closer to zero) than the curve facing the monopolist. The greater the differentiation between a seller's products and other products in the market, the more market power the seller can exercise.[134]

Whether one product is differentiated from another depends

[134] *See* United States v. E.I. du Pont de Nemours & Co., 351 U.S. 377, 392 (1956) ("As the producers of a standardized product bring about significant differentiations of quality, design, or packaging in the product that permit differences of use, competition becomes to a greater or less degree incomplete and the producer's power over price and competition greater over his article and its use, according to the differentiation he is able to create and maintain.").

entirely on consumer perception. Thus, if two products are objectively indistinguishable but are nevertheless perceived by consumers as having different characteristics, which might happen because of branding or advertising, then they are not perfect substitutes. Conversely, two products with objectively different characteristics are perfect substitutes for each other if consumers perceive them as identical.[135]

The standard economic analysis of monopolistic competition resembles that of monopoly in some respects and that of perfect competition in others. In long-run equilibrium, sellers in monopolistic competition earn no monopoly rents. If one seller is making economic profits in the short run, this will induce entry by new market participants that will supply products that are closer substitutes for the first seller's products than what currently exists in the market, and prices will be driven down toward the competitive level. However, since the demand curve slopes downward, marginal revenue is less than price. Therefore, the equilibrium price will be more than marginal cost, resulting in deadweight loss, albeit less than the deadweight loss resulting from monopoly.[136]

Most information goods are offered in markets that are monopolistically competitive.[137] Copyright assures that each product will be unique. Occasionally, as discussed above, these unique goods will have such close substitutes that sellers will have no significant market power. Perhaps even more rarely will a product have characteristics that allow its producer to exercise anything resembling monopoly power. Most information goods fall within the broad range between these extremes. Novels, textbooks, movies, paintings, and recordings of country music and opera stars are all unique, but most of these products have reasonably close substitutes such that if the producer raised its price substantially, a significant proportion of its customers would buy a substitute product instead.

A monopolistic competitor's determination whether to implement TPMs with its product follows exactly the same course as described above for sellers in monopolistic and competitive mar-

---

[135] *See* EDGAR K. BROWNING & MARK A. ZUPAN, MICROECONOMICS: THEORY AND APPLICATIONS 356 (8th ed. 2004).

[136] *See id.* at 357-60; SCHERER & ROSS, *supra* note 70, at 21-25.

[137] *See* Christopher S. Yoo, *Copyright and Product Differentiation*, 79 N.Y.U. L. REV. 212, 246-51 (2004).

kets. The closer the substitute products, the more the demand curves will resemble those of a competitive market; the more distant the substitutes, the more the demand curves will resemble those of a monopolistic market.

### *D. Oligopoly*

We have thus far been assuming that the publisher of an information good decides whether to implement TPMs on a product-by-product basis. That is, a publisher that offers a range of information goods might decide to implement TPMs with some of its products but not with others, depending on the relationship between the respective marginal cost and marginal revenue curves. The market for each good might be competitive, monopolistic, or monopolistically competitive.

In some sectors of the information goods industry, however, publishers might make a single decision whether to apply TPMs to their entire range of products, rather than considering each product individually. This might be a sensible course of action if the costs of gathering and analyzing the data necessary for making optimization decisions for each product exceed the potential benefits or if increasing returns to scale make a catalogue-wide implementation of TPMs advantageous. If only a few publishers dominated the industry sector, the decision whether to implement TPMs would be affected by some of the considerations that enter into the price and output decisions of oligopolists.

Oligopoly is defined by a market structure in which there are few sellers (but more than one) and in which substantial barriers to entry exist.[138] From the standpoint of modeling a firm's optimization decisions, the most significant difference between oligopoly and the two extremes of competition and monopoly is that under oligopoly each producer must take into account the anticipated and actual actions of rival producers.[139] In a competitive market, each producer is small relative to the size of the market; thus, the behavior of any one producer has only a negligible effect on the other firms and can be safely ignored. Under monopoly, there are, by definition, no rivals to be concerned about within a broad range of pricing options (though at some

---

[138] *See* CARLTON & PERLOFF, *supra* note 106, at 7; SCHERER & ROSS, *supra* note 70, at 17-18.

[139] *See* SCHERER & ROSS, *supra* note 70, at 200 ("The basic difficulty facing an oligopolist is uncertainty about rival actions and reactions.").

elevated price, the monopolist must worry about the actions of producers offering distant substitutes).[140]

For this reason, economists find it more difficult to predict firm behavior under oligopoly than under either monopoly or competition. Economists apply a variety of models to oligopoly behavior, differing in their assumptions about firm behavior, such as the extent to which firms manage to cooperate.[141] Collusion among oligopolists results in a combination that behaves like a single monopolist. As the number of rival firms increases, noncooperative behavior leads to outcomes closer to the competitive ideal and to situations resembling a Prisoner's Dilemma, in which each firm may follow a dominant strategy that fails to maximize its profits.[142]

What these oligopoly models have in common derives from the dynamics of both firm and consumer behavior when price and output change. Assuming a firm has some market power, when it raises the price of its product it experiences a reduction in quantity demanded but realizes a higher profit per item sold. Whether it will be profit enhancing to implement a price increase (or, conversely, a price decrease) depends on the relative magnitudes of these two effects. However, the quantity a firm can sell depends not only on its own price but also on the price charged by other firms offering potential substitutes. Thus, under oligopolistic conditions, a change in price by one firm may significantly affect the other firms in the market and call forth a response from those firms. If Firm *A* cuts its price, Firm *B*, which produces a substitute good, may be compelled to cut its price too, lest a large proportion of its customers defect to Firm *A*. A price cut by Firm *B* will have an impact on Firm *A*, which may respond by changing its price. Out of this interaction may come equilibrium at a competitive price level, equilibrium at a supracompetitive level, formation of a cartel that raises price to the monopoly level, or unpredictable oscillation.[143]

The market for recorded music presents an oligopolistic market structure. In 2003, the five major record labels accounted for about seventy-five percent of the industry worldwide.[144] In Au-

---

[140] *See* CARLTON & PERLOFF, *supra* note 106, at 153.

[141] *See id.* at 154-55.

[142] *See id.* at 153-86; SCHERER & ROSS, *supra* note 70, at 199-226.

[143] *See* SCHERER & ROSS, *supra* note 70, at 199-208.

[144] *See Recorded Global Music Sales Down 7.6 Percent*, DCD BUS. REP., Sept. 29, 2004, at *1, *available at* LEXIS News, All (English, Full Text).

gust 2004, two of the majors, Sony and BMG, merged their operations in all markets except Japan,[145] so the bulk of the industry is now controlled by four firms. While the record labels might decide on a CD-by-CD basis whether to implement TPMs (and have done so recently in testing new technologies), a label might decide instead to implement TPMs across its entire catalogue, across an entire genre, or within an entire geographic market. For example, Sony (Japan) announced its decision to eliminate TPMs from all CDs that it releases in the Japanese market.[146]

As we saw above, introduction of TPMs cannot usefully be modeled as a price increase since the effect of the former is not unambiguously to dampen demand. For the same reason, economists' models of oligopoly pricing behavior cannot usefully be applied to model how publishers in an oligopolistic market determine whether to implement TPMs. To develop an appropriate model, we must consider the dynamic effects of the introduction of TPMs in an oligopolistic market.

Suppose, for example, that Universal Music must decide whether to implement anti-copy technology on its CDs and that none of the other major record labels currently uses such technology. Assume that Universal has done the research to determine how many of its current customers are likely to defect to close substitutes and how many unauthorized users are likely to become customers if it adds copy protection. Assume also that, based on this research, Universal determines that the benefits (to it) of adding copy protection will outweigh the costs, and, therefore, it decides to implement this TPM.

Now consider how Universal's move affects its rival Sony BMG. Assume that, before Universal's move, Sony BMG had done its own research and had concluded that adding copy protection would produce a net detriment.[147] But Universal's decision to implement TPMs affects Sony BMG's calculations, for it means that Sony BMG's customers will no longer have an incentive to defect to any CDs in Universal's catalogue, which no

---

[145] *See Sony Corp.: Deal Creating Music Company With Bertelsmann Is Completed*, WALL ST. J., Aug. 6, 2004, at B6.

[146] *See* Steve McClure, *Copy Control Fades in Japan: Labels Turning Away from CCCDs*, BILLBOARD, Oct. 16, 2004, at 41.

[147] Sony BMG's analysis might plausibly yield a result contrary to Universal's if, for example, the closest substitutes for Universal's products are within its own catalogue while the closest substitutes for Sony BMG's belong to the catalogues of other publishers.

longer offer the advantage of being freely copyable. Some of those customers may still defect to a more distant substitute in the catalogue of Warner or EMI, and some may desert the CD market altogether and buy a cassette tape, a movie DVD, a video game, or even a book. Still, Sony BMG can expect that some of the customers it counted as prospective defectors will now remain customers in the face of its own implementation of copy protection. Therefore, Universal's implementation of TPMs may make it profitable for Sony BMG to do the same.

Expressing this same logic in terms of the model developed above, Universal's action causes Sony BMG's **AD** curve to lean more to the right, but leaves its **RD** curve unchanged. This means that Sony BMG's **NCD** curve will lean more to the right, and its **MR** curve will shift upward. This shift may bring the **MR** curve into intersection with the **MC** curve for some anti-copy technology, making it profitable for Sony BMG to implement this technology.

Now, assuming that Sony BMG responds by implementing copy protection, let us consider how this response affects Universal. The Universal customers who were offended by its implementation of copy protection now have fewer places to turn. Those customers whose closest substitute is in Sony BMG's catalogue now have that option cut off, since those CDs are no more copyable than Universal's. Therefore, Sony BMG's adoption of copy protection benefits Universal. Furthermore, now that both Universal and Sony BMG have copy protection, Warner and EMI will have to redo their own calculations as they realize that implementation of copy protection will result in fewer customer defections than they previously anticipated. The resulting shift of their **MR** curves may make it profitable for Warner and EMI to join Universal and Sony BMG in adding copy controls.

Moreover, the anticipation of how the rivals will respond may help to bring about the first firm's initial move. Let us go back to our initial hypothetical in which Universal was deciding whether to implement TPMs. Suppose that Universal's calculations led it to conclude that if it alone were to implement copy controls, the net impact on it would be negative since many of its customers would defect to other labels. Looking ahead one step, Universal might recognize that once it makes its move, one or more of its rivals may find it profitable to respond by adding copy controls, which will have a positive effect on Universal's demand. Univer-

sal might then implement TPMs in the expectation that its rivals will follow suit.

Oligopolistic market conditions may give impetus to an industry-wide shift toward TPMs. As more and more publishers implement TPMs, consumers become more habituated and resigned to this feature of information goods. Once this condition sets in, the TPM is no longer perceived as an annoyance but rather as an inevitable fact of life. For example, the inability to fast-forward through the commercials at the beginning of a DVD movie may have seemed quite noisome the first time it was encountered, but after consumers experience the phenomenon on a dozen different movies they may no longer even notice it. If there are only a few sellers, standardization on a particular product feature that is in the interest of sellers but not of consumers is apt to happen more quickly and lead to a self-reinforcing habituation.

### *E. Summary*

The foregoing analysis shows that a profit-maximizing publisher is subject to the discipline of consumer demand in determining whether to implement TPMs. This is true regardless of whether the market in which the publisher acts is characterized by competition, monopoly, monopolistic competition, or oligopoly. The more competition that exists, the less likely it is, all else being equal, that publishers will find it profit maximizing to implement TPMs. Even under conditions of perfect competition, however, a publisher may find it profitable to implement TPMs, depending on factors such as the incidence of unauthorized use and the sensitivity of its customers to a particular type of TPM.

## VI

## Some Pages of History

As the above discussion indicates, a publisher's decision whether to implement TPMs will be based on its best estimates of (1) the magnitude of recovered demand, (2) the magnitude of alienated demand, and (3) the cost of implementing a TPM. These quantities are not directly observable ex ante, but are the consequences of a variety of contextual factors. For a publisher to determine whether implementing TPMs will promote its interests, the publisher must take these factors into account.

We have already identified two of these contextual factors: the

degree of competition that exists from products that are close substitutes and the direct cost of implementing a TPM. In identifying additional factors, we need not limit ourselves to theory, but may consult history. During the past few decades, publishers of information goods have implemented various types of TPMs. Some of these implementations have been successful; in other cases, the publisher decided to withdraw the TPM.

What follows is a brief review of several examples of the implementation of TPMs. These examples suggest several additional factors that affect the shapes of the alienated demand, recovered demand, and TPM cost curves. If we were able to identify all the factors that determine the shapes of these curves, we might hope to use them as inputs to the model presented in this Article to explain why a publisher decided to implement or withdraw TPMs in any particular context or to make predictions about a publisher's behavior with respect to TPMs. However, while a model can help us recognize how various factors affect the incentives facing economic agents, it is often the case with economic modeling that the ascertainable factors underdetermine human action.

### *A. Case Studies*

#### *1. Software Copy Protection*

In the late 1970s, most publishers of software for personal computers began outfitting their products with anti-copy technology.[148] They adopted this strategy based on their perception that many users of their software were making unauthorized copies of it, allowing others to make use of the software without paying for it.[149]

By 1987 or so, virtually all software publishers had discontinued the use of anti-copy technology. The software publishers' decision to eliminate copy protection has been commonly explained as a response to consumer resistance[150] and to the ease

---

148 *See* Philip Elmer-DeWitt, *A Victory for the Pirates? Software Firms Abandon Their Key Defense Against Illegal Copying*, TIME, Oct. 20, 1986, at 86.

149 *See* Carroll, *supra* note 105, at 33 (citing "industry estimates that as many as half the programs in use on microcomputers were illegal copies").

150 *See* STEWART BRAND, THE MEDIA LAB 202 (1987) (explaining that software publishers "were forced to drop copy-protection schemes . . . because non-copy-protected competitors were grabbing the market"); David M. Hornik, Recent Development, *Combating Software Piracy: The Softlifting Problem*, 7 HARV. J.L. & TECH. 377, 414 (1994) ("[C]opy protection annoyed legitimate users by interfering

with which the technology could be circumvented.[151] Users of the software, particularly institutional customers,[152] complained that copy protection prevented them from making copies for legitimate purposes, such as to install a program from a floppy diskette onto a hard drive or to make a backup copy of the hard drive.[153] Getting "permission" from the software publisher to make a copy for such a purpose could be an arduous undertaking.[154] Evidence that consumers actually did consider copy protection a serious detriment comes from a marketing experiment conducted by software publisher Borland International in 1984. Borland offered a copy-protected version of a program called Sidekick for $54.95 and an unprotected version for $84.95. Despite the fifty-five percent price differential, the unprotected version outsold the protected version by a five-to-one margin.[155]

In a 1998 piece, Julie Cohen presciently suggested that the declaration of consumer victory over software copy protection was

---

with necessary computer functions, such as hard drive installation or data backup."); P. Bernt Hugenholtz, *Copyright, Contract and Code: What Will Remain of the Public Domain?*, 26 BROOK. J. INT'L L. 77, 87 (2000) ("In the 1980s a massive consumer boycott prevented the market success of 'copy protected' software."); Joseph P. Liu, *Copyright Law's Theory of the Consumer*, 44 B.C. L. REV. 397, 425 (2003) ("Consumers rejected [software copy protection] because it made software less useful."); Pamela Samuelson, *Will the Copyright Office be Obsolete in the Twenty-First Century?*, 13 CARDOZO ARTS & ENT. L.J. 55, 59 (1994) ("The main reason for the failure of copy protection schemes was that consumers did not favor them."); Carroll, *supra* note 105, at 33 (quoting Microsoft chairman Bill Gates as declaring, "The customer won."); T.R. Reid, *Consumers Win as More Software Firms End Copy Protection*, WASH. POST, Nov. 10, 1986, at F13 ("[C]ustomers . . . simply refused to buy copy-protected software whenever there was a halfway decent alternative."); T.R. Reid, *Let Freedom—from Copy Protection Gimmicks—Ring*, WASH. POST, Apr. 28, 1986, at F25 ("Corporate buyers (who are mainly MS-DOS users) have told the software houses that they won't shell out any more for programs that are protected.").

151 *See* Kory D. Christensen, Note, *Fighting Software Piracy in Cyberspace: Legal and Technological Solutions*, 28 LAW & POL'Y INT'L BUS. 435, 467 (1997) ("[P]ublishers learned that every copy protection scheme, no matter how sophisticated, was eventually 'cracked' (or defeated) by an equally clever hacker."); Hornik, *supra* note 150, at 414 ("[C]opy protection proved too easy to circumvent; programs quickly emerged that cracked the copy codes, making it possible to copy at will.").

152 *See* Elmer-DeWitt, *supra* note 148, at 86 (the Department of Defense "banned the purchase of any protected programs for DOD use").

153 *See* Carroll, *supra* note 105, at 33 ("[T]he protection devices make it difficult to copy the programs for legitimate reasons."); Reid, *Consumers Win*, *supra* note 150, at F13 ("[I]t is only prudent—indeed, essential—for any personal computer user to make a copy or two of every new program purchased.").

154 *See* Carroll, *supra* note 105, at 33 (describing the steps that a user must go through to obtain a new diskette from the publisher).

155 *See* BRAND, *supra* note 150, at 202; Carroll, *supra* note 105, at 33.

premature.[156] She noted that an important reason for the withdrawal of copy protection was that the 1980s-era copy-protection technologies interfered with legitimate uses of the software, and she observed that the newer generation of these technologies had solved some of those problems.

More recent experience lends support to her analysis. In 2001, Microsoft added product activation, a tethering technology, to its Office XP and Windows XP products.[157] There is no indication that consumer resistance is causing Microsoft to consider removing this TPM. In 2004, product activation started appearing on Macintosh software, including QuarkXPress desktop publishing software and Photoshop image editing software.[158] Product activation eliminates some of the problems associated with the 1980s-era copy-protection schemes: it does not interfere with making a backup copy or installing the program on the hard drive, and it is not prone to cause system crashes. Product activation, however, has its own usability problems.[159]

TPMs for software thus appear to be making a comeback. But before hailing the triumph of the counterrevolution, we must consider the TurboTax tethering episode. In the 2002 tax-year version of its market-leading tax-preparation program, Intuit implemented a tethering TPM using a product-activation system. Intuit said that it decided to implement the measure because it was experiencing a high level of "pass-along piracy"[160]: it sold 7.5 million copies of TurboTax, which were used to file 15 million tax returns.[161] The tethering technology allowed TurboTax to be installed and operated on more than one computer, but TurboTax would print or file the completed tax return only from the machine on which the program had been activated.

The reaction by commentators and consumers was swift and fierce. Walter Mossberg, in his influential Wall Street Journal technology column, denounced Intuit for its decision "to treat all its TurboTax customers like potential criminals," and, on account

---

156 *See* Cohen, *supra* note 6, at 523-26.

157 *See* Walter S. Mossberg, *Microsoft Cracks Down On Sharing Windows Among Home Users*, WALL ST. J., July 5, 2001, at B1.

158 *See* Philip Michaels, *Activation Nation*, MACWORLD, June 2004, at 20.

159 *See supra* note 131.

160 David Becker, *Intuit Offers TurboTax Tests, Apologies*, C—NET, Feb. 24, 2003, http://news.com.com/Intuit+offers+TurboTax™ests%2C+apologies/2100-1040_3-985648.html.

161 *See* Andrew Ratner, *TurboTax Software Fuels Indignation from E-Filers*, BALT. SUN, Mar. 9, 2003, at 1D.

of the product activation requirement, he "emphatically recommend[ed]" that consumers purchase a competing product, H&R Block's TaxCut, instead.[162] Users complained that the tethering measure could be troublesome if they got a new computer after installing the program on an old one,[163] and some swore off TurboTax altogether.[164] H&R Block capitalized on the bad publicity by launching a campaign to persuade TurboTax users to switch to TaxCut, which was TPM-free.[165]

Intuit initially responded by backpedaling, agreeing that its product activation measure was problematic and promising that it would use a different approach in the following year's version,[166] but within a few months, it conceded defeat and announced that it would abandon TPMs altogether.[167] Even more abjectly, Intuit wrote an open letter of apology to its consumers and published the letter in two major newspapers.[168]

Intuit's obtuse implementation of the tethering measure also helped to sink the measure. Installation of TurboTax surreptitiously installed a program that ran in the computer's background, monitoring the computer for use of TurboTax, and that remained on the computer even after the user uninstalled TurboTax. In addition, the TPM worked by storing the activation code on a portion of the hard drive that could not be accessed by the computer user.[169] This implementation spawned rumors that TurboTax was installing a form of spyware on the user's computer. Although Intuit denied this, the company recognized that

---

[162] Walter S. Mossberg, *Of Top Tax Programs, One Has Developed an Insulting Approach*, WALL ST. J., Jan. 30, 2003, at B1.

[163] *See Turbotax Anti-Piracy Code Spurs Backlash*, L.A. TIMES, Jan. 9, 2003, at C3.

[164] *See* Ratner, *supra* note 161, at 1D ("Thousands of customers complained about the maneuver in 'chat rooms' and 'Web logs.' Many identified themselves as longtime, loyal users who, to Intuit's dismay, threatened not to use the product again.").

[165] *See* Lisa Baertlein, *TurboTax Anti-Piracy Limit Gone, Intuit Says*, SAN DIEGO UNION-TRIB., Oct. 13, 2003, at C1.

[166] *See* Becker, *supra* note 160.

[167] *See Intuit Backs Down on Anti-Piracy Feature*, HOUSTON CHRON., May 16, 2003, at 4 ("Intuit will dump an unpopular anti-piracy feature from its top-selling TurboTax software, reversing course on a measure that turned out to be more trouble than it was worth.").

[168] *See Intuit Sorry in TurboTax Piracy Flap*, CHI. TRIB., Oct. 13, 2003, at 8 (describing publication of letter as an advertisement in USA Today and the Wall Street Journal).

[169] *See* Becker, *supra* note 160; Mossberg, *supra* note 162, at B1.

its implementation created a great deal of consumer ill will.[170] The TPM also created difficulties for some users in installing TurboTax.[171]

Intuit's ordeal has not prevented other software publishers from implementing TPMs. For example, Symantec Corp. included a tethering measure in the 2004 version of its Norton AntiVirus software and announced its intention to use product activation in all of its products.[172]

### 2. *The DVD Content Scramble System and User Operation Prohibition Codes*

Movies on DVD, which are by some measures the most rapidly adopted home entertainment format in history,[173] incorporate the Content Scramble System (CSS) TPM. CSS prevents a DVD's content from being accessed on nonconforming playback devices, enables the publisher to prevent a user from copying a DVD using standard equipment, and allows coding of DVDs so that they are playable only on machines manufactured for a particular region of the world. In addition, the DVD-Video standard that is used in encoding DVD movies enables the publisher to incorporate User Operation Prohibition codes, which prevent the user from engaging in certain operations such as fast-forwarding.[174]

Consumer distaste for these measures is evidently robust. A program called DeCSS, which was devised by software hobbyists as a sort of protest against TPMs and allowed CSS-encrypted DVD movies to be decrypted and copied in degraded form onto a compact disc, has been widely available for download since late 1999, despite a judicial determination that DeCSS violates the antitrafficking provisions of the DMCA.[175] Several companies offered software that allowed users to make copies of CSS-en-

---

[170] *See* Hiawatha Bray, *TurboTax Feature Draws Flak: Intuit Denies 'Spyware' Charge*, BOSTON GLOBE, Jan. 10, 2003, at C3.

[171] *See* Ratner, *supra* note 161, at 1D (describing travails of one sophisticated user who was unable to activate his installation).

[172] Mike Musgrove, *Norton AntiVirus to Include Product Activation Code*, WASH. POST, Aug. 29, 2003, at E1.

[173] *See* Jim Krane, *Half of U.S. Homes Now Have DVD Players*, Feb. 6, 2003, http://www.detnews.com/2003/technology/0302/06/technology-78165.htm.

[174] *See supra* note 16.

[175] *See* Universal City Studios, Inc. v. Reimerdes, 111 F. Supp. 2d 294, 311 (S.D.N.Y. 2000), *aff'd sub nom.* Universal City Studios, Inc. v. Corley, 273 F.3d 429 (2d Cir. 2001).

crypted DVDs, but lawsuits involving the movie studios caused the most prominent supplier of this software to shut down.[176] Many users probably find it irksome that they cannot fast-forward past the FBI warning or the trailers at the beginning of a DVD. Nevertheless, there is no evidence that movie studios are about to eliminate their use of these TPMs in response to consumer preferences.

### 3. *DIVX DVD Format*

The DIVX format for DVD movies[177] is, like the TurboTax experience, an example of a TPM implementation that quickly went down in flames. Introduced in September 1998, DIVX was a proprietary format for encoding data on a DVD that was backed principally by Circuit City, a national consumer electronics retailer. The system allowed the user of a DIVX disc to view it as many times as desired, but only within a set period of time, usually 48 hours, after the initial viewing.[178] The DIVX player was connected to a central server via a telephone line, enabling the user, upon payment of a fee, to reactivate a disc for additional viewing time or to remove the viewing restriction entirely.

Introduction of the DIVX format gave rise to an anti-DIVX movement, which flowered in the form of websites urging consumers not to buy the discs.[179] Several constituencies opposed DIVX, including Circuit City's competitors, video rental stores, and content owners that favored video-on-demand.[180]

DIVX never gained wide popularity. An alternative format for DVD movies based on the DVD-Video standard had been introduced in the United States in 1997. Although early DVD players were priced at $1,000 and up, the price rapidly dropped, and DVD-Video was quickly adopted.[181] In June 1999, Circuit

---

176 *See 321 Studios Ends Operations*, N.Y. TIMES, Aug. 5, 2004, at C6; 321 Studios v. Metro Goldwyn Mayer Studios, Inc., 307 F. Supp. 2d 1085 (N.D. Cal. 2004); Paramount Pictures Corp. v. 321 Studios, No. 03-CV-8970, 2004 WL 402756 (S.D.N.Y. March 3, 2004).

177 The DIVX technology discussed here should not be confused with the MPEG-4 video compression standard, which is known as DivX.

178 *See* R. J. Dunnill, *The Origins of the Original Divx,* Jan. 17, 2002, http://www.g4techtv.com/techtvvault/features/35912/The_Origins_of_the_Original_Divx.html.

179 *Id.*

180 *See id.*

181 *See DVD Frequently Asked Questions (and Answers)*, § 1.5, http://www.dvddemystified.com/dvdfaq.html (last visited Nov. 5, 2005).

City announced that it was discontinuing the DIVX format.[182]

A variant on the DIVX concept has recently hit the market in the form of self-destructing DVDs. The discs begin to degrade after being exposed to the air and become unusable after forty-eight hours.[183]

### *4. Copy Protection on Music CDs*

In the past few years, record labels have been experimenting with implementing copy protection TPMs on their music CDs, with mixed results. There were some early missteps—some TPMs made CDs unplayable in computers and automobile CD players and even damaged computer CD drives,[184] while other TPMs were easily circumvented.[185] Copy-protected CDs were not well received in Japan, which prompted Sony Japan to discontinue copy protection, and independent label Avex to reduce its use of the technology.[186] Sony's move has been ascribed to discontent by its customers, who found that the TPM prevented them from converting songs into MP3 format so that they could be played on portable MP3 players.[187]

Still, use of copy protection for music CDs seems to be on the upswing in Europe and the United States. One reason for this may be a shift in the technology employed. Previous copy-protection systems prevented all copying and were implemented in a way that caused some CDs to be unplayable on a computer CD-ROM drive. The new copy-protection technology allows a cer-

---

182 *See DIVX Bites the Dust,* June 21, 1999, http://hometheater.about.com/library/weekly/aa062199.htm.

183 *See* Rachel Abramowitz, *Is the Concept of Throwaway DVDs Really a Keeper?*, L.A. TIMES, Oct. 18, 2004, at E1.

184 *See* Howard Cohen, *Compact Risk*, MIAMI HERALD, July 3, 2002, at 1C.

185 One TPM could be neutralized by marking the rim of a protected CD with a black felt-tip marker. *See* Cliff Edwards, *A Big Hole in Sony's Copyright Shield?*, BUS. WK., June 10, 2002, at 12 ("'They spend millions on copy protection, and a 20 cents marker breaks it. haha,' said one posting on geek.com."). Another TPM could be avoided by holding down a computer's shift key while loading the CD. *Hit CD with Copy Protection May Signal Fan Acceptance*, SAN JOSE MERCURY NEWS, June 23, 2004, at *1, *available at* 2004 WL 81868206 (quoting the CEO of a TPM-maker describing the shift-key workaround as a feature, not a bug) (electronic copy on file with author).

186 *See* McClure, *supra* note 146, at 41.

187 *See Angry Consumers Prompt Sony Music to Drop CD Copy Protection*, ASIA PULSE, Oct. 1, 2004, at *1, *available at* LEXIS News ("The switch was prompted by consumers who are frustrated with the copy-protected format because it prevents them from downloading music to portable digital music players such as APPLE COMPUTER INC.'s iPod.") (copy on file with *Oregon Law Review*).

tain number of copies of protected CDs to be made, which enables users to create portable MP3 files. The record labels view the new approach as a compromise, since it makes the TPM more palatable to consumers while still preventing unlimited copying.[188]

### *B. Factors Influencing a Publisher's TPM Calculations*

The experiences with TPMs recounted above suggest several factors that go into determining the recovered demand, the alienated demand, and the total cost associated with the implementation of a TPM. It is apparent that a publisher's decision whether to implement TPMs depends on several considerations that do not enter into the standard analysis of a firm's profit-maximizing decision making. In particular, the characteristics of the available TPMs weigh heavily in the calculations.

#### *1. The Degree of Competition*

As already noted, the existence of close substitutes has the effect of decreasing recovered demand and increasing alienated demand. This means that the marginal revenue curve will shift down, making it less advantageous for a publisher to implement TPMs. The existence of close substitutes is well correlated with the outcomes discussed above. Close substitutes were available for the 1980s-era software[189] and the 2002 version of TurboTax.[190] Microsoft's Windows XP and Office XP, on the

---

[188] *See* John Ross, *More Music CDs Protected from Pirates*, COLUMBUS DISPATCH, Nov. 8, 2004, at 1E ("To address playability problems, companies developing anti-piracy software have shifted from programs that render discs unreadable in computers to those that control the number of copies made on Macs and PCs."); Eric Schumacher-Rasmussen, *Get in the Ring: Major Labels Get More Aggressive with Copy-Protection Technology*, EMEDIA, Oct. 1, 2004, at 8 (noting that the new technology "should take care of one of the biggest consumer complaints about copy-protected CDs so far: . . . fans can't copy tracks from some discs to their iPods or other MP3 players.").

[189] *See* Samuelson, *supra* note 4, at 566 n.245 ("Firms with similar products who were willing to sell their products without copy-protection systems attracted enough customers that the leading firms eventually abandoned their technical protection schemes."); Reid, *Consumers Win*, *supra* note 150, at F13 ("There now is so much great software around in nonprotected form that a buyer has no need to buy copy-protected software.").

[190] *See* Alan S. Kay, *Rating the Tax Programs*, WASH. POST, Feb. 15, 2004, at F7 ("Both the [TurboTax and TaxCut] programs look and work remarkably alike . . . ."); Mossberg, *supra* note 162, at B1 (describing TurboTax and TaxCut as "nearly identical").

other hand, lack close substitutes.[191] In the case of DIVX, the close substitute was an alternative format, DVD-Video, rather than alternative content. DVDs, with their accompanying CSS encryption, may be viewed as having a close substitute in an alternative format, VHS videotape, or as having no close substitute since DVDs have a number of features that consumers appear to value and that VHS tapes lack. Music CDs may be viewed as having many close substitutes, if the CDs are considered individually, or as having few, if the record labels act like oligopolists.

### 2. *Legal Prohibition of Circumvention*

Since section 1201 became effective,[192] it has become more costly for consumers to circumvent access controls and use controls. The costs include the risk of legal liability and the time and expense of locating or creating circumvention technology. As a result of this increased cost, an unauthorized user may find it cheaper to buy an authorized version of the product than to use circumvention technology. The result is to increase the recovered demand and, correspondingly, to shift the marginal revenue curve upward. In the 1980s, there were no clear rules against circumvention of TPMs, and the first court challenge of an anti-anti-copy technology resulted in a determination that the circumvention device did not violate the copyright laws since it had a substantial noninfringing use.[193] Thus, the 1980s copy-protection technology, unlike the Windows XP and TurboTax technologies, did not have the benefit of legal prohibitions on circumvention. DIVX's brief existence roughly coincided with the effective date

---

[191] This is less true for Office than for Windows. Although several of the Office program formats have become de facto standards for exchanging documents, a free open-source version of Office is available. *See* OpenOffice.org, http://www.openoffice.org. Free software, however, is not without its costs: users may choose to buy Office XP with its TPM rather than using OpenOffice.org because information costs have prevented them from learning about the free version, because of feared or actual incompatibilities presented by the free version, because less technical support or less frequent bug fixes are available, because the free version has fewer features, etc.

[192] The prohibition on trafficking in technologies for circumventing access controls and use controls became effective in October 1998. Digital Millennium Copyright Act, Pub. L. No. 105-304, § 105, 112 Stat. 2860 (1998) (codified at 17 U.S.C. § 1201(a)(2), (b)(1) (2000)). The effective date of the prohibition on the act of circumventing access controls was delayed until October 2000 to allow the Librarian of Congress time to engage in the first triennial rulemaking on exceptions from this prohibition. *See id.*, 17 U.S.C. § 1201(a)(1) (2000).

[193] *See* Vault Corp. v. Quaid Software Ltd., 847 F.2d 255, 267 (5th Cir. 1988).

of section 1201, and it probably did not benefit from the anticircumvention rules. DVD-Video was born in the pre-section-1201 era, but it has spent most of its life under section 1201 protection.

### 3. *Ease of Circumvention*

An ideal TPM would be impossible to circumvent. In reality, any TPM can be circumvented; the only uncertainty is how much the circumvention will cost.[194] The less effective a TPM is in preventing unauthorized use, the closer to the vertical axis the recovered demand curve will tend to remain, resulting in a downward shift of the marginal revenue curve and less-favorable conditions for implementing the TPM.

The 1980s-era copy protections were easily circumvented.[195] By contrast, the Windows XP and TurboTax activation and the DIVX time limitation appear difficult to circumvent.

### 4. *The Annoyance Factor*

TPMs vary in the extent to which they interfere with a consumer's use of the associated information good. Some TPMs are intentionally more restrictive than others. Music files downloaded from iTunes may be played on up to five computers,[196] while Adobe eBooks are tethered to two machines;[197] unlimited numbers of first-generation copies can be made from DAT tapes, but DVDs cannot be copied at all.

TPMs may also interfere with usability in ways not intended by the publisher. Most publishers probably would not mind if a customer made a backup copy of an information good as long as it was used for backup purposes only,[198] yet anti-copy TPMs prohibit copying altogether. A product activation technology that

---

[194] Note that one element of the cost of circumvention is the expected cost of legal liability, which a publisher can affect by adopting a more or less aggressive policy of discovering and bringing lawsuits against those who engage in circumvention.

[195] *See supra* note 151.

[196] *See* Apple, *Share Easily. Stream Wirelessly.*, http://www.apple.com/itunes/share.html (last visited Nov. 5, 2005).

[197] *See* Adobe, *Frequently Asked Questions: eBook Users (Adobe Reader 6.0)*, http://www.adobe.com/support/techdocs/329059.html (last visited Nov. 5, 2005) ("You can view an eBook on one PC or Macintosh and on one PalmOS device.").

[198] Contrary to this proposition is the opinion of former Motion Picture Association of America head Jack Valenti, who reportedly said, "If you buy a DVD you have a copy. If you want a backup copy you buy another one." Anick Jesdanun, *DVD-Duplication Software Maker to Modify Products*, SAN JOSE MERCURY NEWS, Feb. 24, 2004, at 3C.

requires the user to contact the publisher to reactivate the product each time a new piece of software is installed on the user's computer causes more non-productive usability problems than a technology that requires reactivation only with significant changes in hardware configuration.

An ideal TPM would also never malfunction. In the real world, a TPM will sometimes interact unpredictably with the equipment that is used to view or hear the information good. For example, some copy-protected music CDs cannot be played in the CD-ROM drives of certain computers.

The greater the annoyance factor that a TPM presents, the more its use will increase the alienated demand and the more the marginal revenue curve will shift downward. In addition, a higher annoyance factor means that the publisher will incur greater costs in providing technical support to its customers, which will shift the marginal cost curve upward. Both of these effects make it less likely that the publisher will implement the TPM.

The 1980s-era copy-protection technologies generated many consumer complaints about usability issues. In contrast, the Windows XP and TurboTax activation technologies seem to create usability problems for only the small segment of users who change their hardware after activation, and DIVX created no substantial reported usability problems.

### 5. *Extent of Unauthorized Use*

The outcome of the publisher's calculations will depend on the extent of unauthorized use of the product in question. If there is very little unauthorized use, then there can be very little demand for the publisher to recover by implementing TPMs. Thus, the less unauthorized use that occurs, the closer to the vertical axis the recovered demand curve will be and the less benefit the publisher will experience from implementing TPMs.

The publishers of 1980s-era software, TurboTax, and Windows XP all perceived high levels of unauthorized use of their products. In the case of DIVX, the only use that it prevented was watching a movie on a rented DVD more than 48 hours after its first viewing. It is unclear whether movie publishers considered this an unauthorized use at all.

### *6. The Salience Factor*

If the implementation of a TPM achieves notoriety through widespread publicity, more potential users will learn about it, and alienated demand will increase. The TurboTax tethering TPM was the focus of a great deal of negative publicity, due in part to articles by Walter Mossberg and other journalists. The TPMs discussed in the other case studies have achieved varying degrees of salience.

### *7. The Third-Party Factor*

TPMs vary in the extent to which their success depends on the cooperation of third parties—that is, parties other than the entity promoting the technology and the consumers who must decide whether to buy implementations of it. The DIVX system was highly dependent on cooperation by third parties. Circuit City could unilaterally introduce the DIVX standard, but the technology could not succeed in the marketplace unless consumer electronics companies cooperated by manufacturing DIVX-compliant players, movie studios cooperated by releasing their content on DIVX discs, and retailers (with which Circuit City was in competition) cooperated by selling the DIVX players and discs.

By contrast, the other TPMs considered in the case studies were promoted by the publishers of the relevant information goods, which prevented publishers from forming a nay-saying third party. Copy protection schemes applied to software and music CDs require no third-party cooperation because they work on existing hardware. CSS required the codevelopment of compliant hardware, but the movie studios avoided a roadblock here by involving the consumer electronics and personal computer industries early in the process of developing the CSS standard.[199]

## *C. Predictive Value of the Model*

Can the empirical factors identified above serve to explain why a publisher decided to implement or discontinue TPMs in a particular product? Can they predict whether a proposed TPM im-

[199] *See* Trial Transcript at 476-80, Universal City Studios, Inc. v. Reimerdes, 111 F. Supp. 2d 294 (S.D.N.Y. 2000) (No. 00 Civ. 277) (Testimony of Marsha King), *available at* http://www.eff.org/IP/Video/MPAA_DVD_cases/?f=20000719_ny_trial_transcript.html, *aff'd sub nom.* Universal City Studios, Inc. v. Corley, 273 F.3d 429 (2d Cir. 2001).

plementation will succeed? If we tabulate these factors for each of the case studies described above, we find that they offer modest predictive value.

In the following Table 1, a "+" indicates a factor favoring implementation of TPMs, a "–" represents the contrary, and a "?" means the factor is neutral or uncertain. The entries for 1980s-era software and Windows XP correspond to the historical experience, but the TurboTax entries do not seem to fit the expected outcome. The entries for the other case studies are inconclusive.

The modesty of the model's predictive power is not surprising. A publisher's decision concerning the implementation of TPMs will inevitably be influenced by a variety of contextual factors not closely related to the factors incorporated into the model. For example, Intuit's decision to drop the tethering measure from TurboTax may have owed something to Intuit's desire to maintain its reputation as a consumer-friendly enterprise, as suggested by its publication of an open letter of apology and by the fact that it dropped the TPM even though it apparently yielded significant short-term financial benefits.[200] In addition, there is no reason to think that all of the factors should receive equal weight. The circumstance that TurboTax had a strong rival in TaxCut, and the fact that TaxCut's publisher sought to capitalize on Intuit's distress by luring its customers away with a campaign focusing on the fact that TaxCut was TPM-free, might have been enough to overwhelm all of the other factors. Finally, performance of the calculations needed to determine whether implementation of TPMs is in a publisher's interest is not a deterministic exercise but involves a variety of estimates and downright guesses about consumer behavior that may turn out to be erroneous.

The model does, however, yield another set of predictions that goes beyond what could be derived if we modeled TPMs as a price increase. Several of the empirical factors described above (and set out in Table 1) lie within the publisher's control to a greater or lesser extent. A publisher can improve the benefits that it receives from implementing TPMs by manipulating these factors. Specifically, a publisher can (1) adopt TPMs that are less subject to circumvention, (2) favor TPMs that create a minimum

[200] *See* Baertlein, *supra* note 165, at C1 (reporting that TurboTax sales increased by twenty-five percent over the previous year for the calendar quarter ending in April 2003).

TABLE 1

| | 1980s Software | Windows XP | TurboTax | DVD CSS and UOP | DIVX | Music CD Copy Protection |
|---|---|---|---|---|---|---|
| **Competition** | – | + | – | ? | – | ? |
| **Legal Prohibition** | – | + | + | –, then + | – | + |
| **Ease of Circumvention** | – | + | + | + | + | ? |
| **Annoyance Factor** | – | + | + | + | – | ? |
| **Extent of Unauthorized Use** | + | + | + | + | – | + |
| **Salience Factor** | ? | – | – | ? | – | ? |
| **Third-Party Factor** | + | + | + | +, – | – | + |
| **Result** | Implemented, then withdrawn. | Implemented. | Implemented, then withdrawn. | Implemented. | Implemented, then quickly withdrawn. | Implemented unevenly; still in experimental stage. |

**Key**: "+" means the factor favors implementation of TPMs.
"–" means the factor disfavors implementation of TPMs.
"?" means the factor is neutral or uncertain.

of annoyance to authorized users, (3) use TPMs only in connection with products that are experiencing a relatively high degree of unauthorized use, and (4) involve relevant third parties early in the development process to prevent them from hindering the successful deployment of the TPM. We may also anticipate that TPM designers will strive to improve the technology by making TPMs harder to circumvent and by reducing the annoyance factor.

Microsoft seems to have been cognizant of the annoyance factor and the degree-of-unauthorized-use factor in deciding to release a corporate version of Windows XP that requires no activation.[201] Enterprises that make frequent hardware changes to their computers will experience a higher level of annoyance than home users because they are more likely to need to go through the process of contacting Microsoft to reactivate the software. Corporate users with a site license may be less likely than home users to attempt to use a single copy of XP on more than one computer.

## CONCLUSION

The model developed in this Article reflects a recognition that the dynamics of a publisher's decision whether to incorporate TPMs in its products differ from those that apply when a typical firm makes price or output decisions, despite the fact that the firm's goal is profit maximization in both cases. Adding TPMs to information goods cannot accurately be modeled as either a price increase or an undesirable product characteristic. The proposed model takes into account the special characteristics of TPMs, including their ambiguous effect on demand and the fact that publishers incur implementation costs while making their products less desirable to some consumers.

The model indicates that a publisher's calculations will be highly influenced by consumer preferences. Those preferences determine the shapes of the alienated demand and recovered demand curves and can significantly affect the costs associated with the implementation of a TPM.

The shapes of the relevant curves are also affected by a variety of contextual factors, which emerge from several case studies involving implementation of TPMs. As in the context of price

---

[201] *See* Yardena Arar, *Product Activation Hacked*, PC WORLD, Jan. 2002, at 19.

and output decisions, market structure plays an important role, but factors specific to the technology of TPMs are also highly relevant.

The proposed model of publisher decision making, together with the anecdotal evidence offered by the case studies, suggests that profit-maximizing publishers that face competition have meaningful incentives to be responsive to consumer TPM preferences. Publishers in markets that are monopolistic, monopolistically competitive, or oligopolistic face correspondingly less pressure from such consumer preferences than do publishers in competitive markets.