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Economic Analysis of Technological Protection Measures

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John A. Rothchild[1]

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

Introduction

The use of technological protection measures ("TPMs") by publishers[2] of information goods[3] to prevent unauthorized use of those goods — for example, to prevent a music CD from being copied, or to disallow use of a particular copy of a computer program on more than one computer — is transforming the ways in which consumers interact with information goods. The current trend by publishers to protect their goods using TPMs gained impetus from 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 to engage in certain acts of circumventing those protections.

Congress enacted those provisions in response to the importunities of publishers, who insisted that they would not make their products available in digital formats unless

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[2] I use the term "publisher" to refer to the 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.

[3] 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 circumvention of TPMs protecting analog information goods. *See* 47 U.S.C. § 553(a) (prohibiting intercepting cable television broadcasts, or providing equipment for this purpose); 17 U.S.C. § 1201(k)(1) (prohibiting video cassette recorders that lack prescribed copy control technology).

they were provided with effective means of preventing unauthorized appropriation of the content of those products. In responding as it did, Congress accepted the proposition that copyrighted works in digital formats are more at risk of infringing use than are those in analog formats, given the ease with which multiple generations of perfect copies may be made and distributed via digital networks. While TPMs in theory secure these works against infringing use, in practice any technological protection can be and usually has been defeated by application of sufficient ingenuity. The DMCA's anti-circumvention 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 greeted the anti-circumvention rules with joy, others have probed to uncover their darker aspect. As many commentators have noted, the use of TPMs, backed up by the legal sanctions of the anti-circumvention rules, has effects that extend well beyond the securing of digital content against infringing use. 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, non-commercial copying of music, non-public performance and display, and accessing a work using an unapproved device, as well as uses whose legal validity is yet unresolved, such as copying for personal archival purposes. 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* so develop. Publishers are not required to deploy TPMs, but 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, since 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 by a prominent Clinton

[4] *See* Lucas Graves, *Has TiVO Forsaken Us?*, WIRED (Nov. 2004), at 150 ("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.") (interview with TiVo General Counsel Matthew Zinn, commenting on TiVo's decision to add TPMs to its digital video recorder); 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, 138 (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."); 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."); David Nimmer, *A Riff on*

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]

To assess whether it is reasonable to rely upon market forces to discipline publishers in their use of technological protection measures, thereby preventing the development of constraints on the use of information goods that the community of users does not desire, we need to understand the factors that are relevant to a rational publisher's decision

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Fair Use in the Digital Millennium Copyright Act, 148 U. PA. L. REV. 673, 740 (2000) ("market forces" may prevent the pay-per-use world from coming to be); CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES 98 (1999) (explaining to entrepreneurs that use of TPMs may increase their sales but require them to lower prices, possibly reducing profits); Pamela Samuelson, *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."); 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.").

[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*] (testimony of Bruce Lehman) ("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.").

[6] *See* Chad Woodford, Comment, *Trusted Computing or Big Brother? Putting the Rights Back in Digital Rights Management*, 75 U. COLO. L. REV. 253, 279 (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."); 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."); James Boyle, *Cruel, Mean, or Lavish? Economic Analysis, Price Discrimination and Digital Intellectual Property*, 53 VAND. L. REV. 2007, 2033 (2000) (it is difficult for a consumer 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, 520-21 (1998) ("There is . . . insufficient information from which to conclude that, in a mature market, vendors of substitutable products will compete to offer less restrictive access terms.").

whether to implement TPMs in its products, and the empirical conditions that these factors depend upon. 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' decisions on price and quantity. As I explain, a customized model is required because implementation of TPMs cannot realistically be modeled either as a price rise or as a product characteristic that consumers dislike.

The model provides several insights. It disaggregates the empirical conditions that affect a publisher's decision whether to implement TPMs to control use of its information goods, illuminating the impact of several factors that a more traditional model conflates or ignores. Doing so 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 permits recognition of the fact that implementation of TPMs 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 describes the most common forms of TPMs in current use. Part II sets out the development and operation of the anti-circumvention provisions of the DMCA. Part III makes a case for the double-edged nature of legally backed TPMs: they offer the benefit of providing copyright owners with a tool that enables them to vindicate their rights under the Copyright Act, 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 they entail for publishers implementing them. The publisher's decision whether to implement TPMs is shown to depend upon a combination of three factors: two offsetting effects on consumer demand, and one cost element. Part V demonstrates how the model applies to markets for several types of information goods, featuring a range of market structures: pure competition, monopolistic competition, monopoly, and oligopoly.

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 affect how consumer demand and the publisher's costs are affected by 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 TPMs in common use generally are software based,[7] and rely upon encryption together with some sort of authorization code

[7] Hardware-based technological protections are less common. There are devices called "dongles," also known as "hardware keys," that 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

that permits decryption.[8] The efficacy of TPMs that are in widespread use 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, graphics, or other modes of communication that humans can appreciate. 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 application of a TPM consisting of a wrapper secured by a padlock — but TPMs of this sort are not at present of much practical significance.[9]

Several varieties of TPMs are in common use, with others in various stages of conception or development.

First, and perhaps most common, are measures 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 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

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Encyclopedia Britannica came with a dongle that prevented it from being copied. *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 ("mostly 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), was a hardware/software hybrid.

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

[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. Rep. No. 105-551 (pt. I) (1998), at 17. *See also WIPO Treaties Hearings*, *supra* note 5, at 49 (Prepared Statement of Marybeth Peters) ("Under existing law, it is not permissible to break into a locked room in order to make fair use of a manuscript kept inside."). The metaphor is inapt. Among other things, circumvention involves no physical trespass. *See* Charles Fried, Book Review, *Perfect Freedom or Perfect Control?*, 114 HARV. L. REV. 606, 629 n.17 (2000).

[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).

used in connection with streaming audio or video in RealNetworks format;[12] the anti-copying technology used to prevent copying of pay-per-view television broadcasts and movie videotapes;[13] and the Serial Copy Management System, which prevents multiple-generation copying of recordings on digital audio tape.[14]

Second, there are "tethering" systems that limit the devices in connection 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.[15] The Content Scramble System 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.[16]

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 publisher to prevent the viewer from engaging in certain actions, such as fast-forwarding through the commercials, by inserting User Operation Prohibition codes on the disk.[17]

Fourth, there are TPMs that control the transmission of content from one device to another. The "broadcast flag" implements such a system. The Federal Communications Commission has mandated that all devices capable of receiving digital television broadcasts that are manufactured starting July 1, 2005 must incorporate a system that

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[12] *See* RealNetworks, Inc. v. Streambox, Inc., 2000 WL 127311, *2 (W.D. Wash. 2000).

[13] *See* 17 U.S.C. § 1201(k) (requiring video cassette recorders to be equipped with "automatic gain control technology").

[14] *See id*. § 1002 (requiring digital audio tape machines to be equipped with the "Serial Copy Management System").

[15] *See* United States v. Elcom Ltd., 203 F. Supp. 2d 1111, 1118 (N.D. Cal. 2002) (describing the Adobe Acrobat eBook Reader tethering system).

[16] *See* Sony Computer Entertainment America Inc. v. GameMasters, 87 F. Supp. 2d 976, 981 (N.D. Cal. 1999).

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

recognizes the presence of a series of bits embedded in a broadcast indicating that the broadcaster has designated the material for controlled redistribution. The device must be designed to honor the broadcaster's insertion of this flag by preventing redistribution of the material to unapproved devices.[18]

On the horizon is a proposal to build into computer hardware and operating systems mechanisms that control all operations to prevent a range of unauthorized actions. Microsoft is in the process of developing such a "trusted computing" system, which it refers to as "Palladium."[19]

II. The Anti-Circumvention Provisions of the DMCA

In 1998, Congress enacted a set of provisions designed to increase the efficacy of TPMs.[20] The weakness of TPMs, from the 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;[21] the DeCSS code, which defeats the CSS protection of DVDs;[22] and the Streambox technology, which defeats RealNetworks' Secret Handshake and Copy Switch.[23] Software code 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 enactment of the DMCA, some publishers expressed unwillingness to release their products in digital formats unless TPMs could be secured against circumvention.[24] Unauthorized copying of digital goods is of particular concern to publishers, since, unlike information goods in analog formats, digital goods can be copied through multiple

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[18] 47 CFR § 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), http://www.cdt.org/copyright/broadcastflag.pdf.

[19] *See* Woodford, *supra* note 6, at 279-83 2004.

[20] 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).

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

[22] *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).

[23] *See* RealNetworks, Inc. v. Streambox, Inc., 2000 WL 127311 (W.D. Wash. 2000).

[24] *See* Universal City Studios, Inc. v. Reimerdes, 111 F. Supp. 2d 294, 304 (S.D.N.Y. 2000) ("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."), *aff'd sub nom.* Universal City Studios, Inc. v. Corley, 273 F.3d 429 (2d Cir. 2001); Dan L. Burk & Julie E. Cohen, *Fair Use Infrastructure for Rights Management Systems*, 15 HARV. J.L. & TECH. 41, 47-48 & n.20 (2001).

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,[25] but became law through a circuitous route. When Congress did not adopt the Task Force's proposal, the U.S. delegation to the World Intellectual Property Organization raised a similar proposal in the context of negotiations to develop what became two 1996 treaties updating the international copyright legal regime.[26] WIPO adopted a watered-down version 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.[27] Congress then enacted the DMCA's anti-circumvention provisions for the stated purpose of implementing these treaty provisions.[28]

The anti-circumvention 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.[29] 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.[30] 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.[31]

The difference between the second and third prohibitions is difficult to discern from the face of the statute.[32] The second refers to devices that permit unauthorized *access*,

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[25] INFORMATION INFRASTRUCTURE TASK FORCE, INTELLECTUAL PROPERTY AND THE NATIONAL INFORMATION INFRASTRUCTURE: THE REPORT OF THE WORKING GROUP ON INTELLECTUAL PROPERTY RIGHTS (1995).

[26] WIPO Copyright Treaty, Dec. 20, 1996, WIPO Doc. CRNR/DC/94; WIPO Performances and Phonograms Treaty, Dec. 20, 1996, WIPO Doc. CRNR/DC/95.

[27] WIPO Copyright Treaty, *supra* note 26, art. 11; WIPO Performances and Phonograms Treaty, *supra* note 26, art. 18.

[28] S. Rep. No. 105-90, 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.

[29] 17 U.S.C. § 1201(a)(1)(A).

[30] *Id*. § 1201(a)(2).

[31] *Id*. § 1201(b)(1).

[32] *See* David Nimmer, *Appreciating Legislative History: The Sweet and Sour Spots of the*

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 *use* control is not. The justification for this is simple, though the ramifications are a bit more subtle. There is no need to ban the act of circumventing a use control, since that act, constituting as it does an unapproved exercise of one of the copyright owner's exclusive rights, is already forbidden by the Copyright Act, and Congress did not wish to modify the grounds of such liability.[33] The three types of conduct that section 1201 does ban — trafficking in devices that circumvent access controls, ditto for those 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 anti-circumvention provisions, such an act of circumvention is no violation if it lies within one of the exceptions to infringement liability contained within the Copyright Act.[34] The broadest and most important of these exceptions are the privilege of fair use,[35] the exclusion of protection for ideas (as opposed to expression),[36] and the first-sale doctrine.[37] 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 any other conduct permitted by the Copyright Act. As a practical matter, however, she may be unable to exercise this right, since it is probably unlawful for anyone to supply her with the technology necessary to circumvent the control.[38]

DMCA's Commentary, 23 CARDOZO L. REV. 909, 948-49 (2002).

[33] S. Rep No. 105-190 (1998), at 12.

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

[35] *Id*. § 107.

[36] *Id*. § 102(b).

[37] *Id*. § 109(a) (limiting the distribution right); § 109(c) (limiting the display right). Other limitations on the exclusive rights include privileges for libraries, § 108; exemption of certain performances and displays, § 110; exemptions and statutory licenses for certain digital transmissions of sound recordings, § 114(d), (f); compulsory licensing of mechanical reproductions of musical works, § 115; and copying computer programs for use and backup, § 117. Section 1008, 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.

[38] *See* Nimmer, *A Riff*, *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.

However, fair use and the Copyright Act's other exceptions to the exclusive rights are not available to justify an act of circumventing an *access* control. This is because the Copyright Act's exceptions do not apply to violations of section 1201, but only to the section 106 rights. As one court has explained,[39] Congress chose to balance the interests of copyright owners and users 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,[40] and by creating a mechanism by which the Librarian of Congress may create additional exceptions through triennial rulemaking proceedings.[41]

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 exert maximum control will always include an access control, even if they are concerned only to prevent infringing uses.[42] 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 access to and use of their products, for the purpose of encouraging them to release their products in digital formats. Should we be concerned about the possibility that publishers may overuse these technologies? Can there be too much of a good thing?

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

[39] 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).

[40] 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, 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).

[41] 17 U.S.C. § 1201(A)(1)(B) – (E). The two rulemakings that have been conducted so far have exempted very narrow classes of works. *See* Copyright Office, *Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies*, 68 Fed. Reg. 62,011 (Oct. 31, 2003) (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); Copyright Office, *Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies*, 65 Fed. Reg. 64,556 (Oct. 27, 2000) (exempting only two categories of works). The exemption allows circumvention of access controls for non-infringing uses only.

[42] *See* Reese, *supra* note 38, at 640-41 (suggesting that publishers will have an incentive to employ "merged" access and copy controls).

This section discusses four types of negative impacts that result from use of TPMs: contraction of the public domain, a general reduction of access to digital goods, harm to competition, and invasion of privacy. The existence of these detriments means that expanded use of TPMs is not an unalloyed good.

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.[43] One element that goes into the construction of the public domain is the limitations on the copyright owner's exclusive rights that are built into the Copyright Act. Though a work is copyrighted, I need no permission from the copyright owner to make a variety of public and private uses of it.[44]

The availability of TPMs, augmented by the section 1201 prohibition on circumventing (or supplying 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 with a cassette player but no CD player.[45] Copy controls prevent fair-use copying of streaming video to allow it to be shown at a location lacking a live Internet connection. The Content Scramble System protecting a movie DVD makes it impossible to compile a series of clips, and the region coding system prevents lending or selling a U.S.-designated DVD to a user in Europe. 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. TPMs like the broadcast flag limit the ability of consumers to "time-shift" and "space shift" television broadcasts.[46] To the extent that public-domain materials cease to be available in formats other than ones protected by TPMs, those materials may be converted from public-domain to pay-per-use status.[47] The existence of TPMs that make it feasible for publishers to charge licensing

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[43] This is a somewhat deviant use of the term "public domain." Usually it refers to works that are free of any control by a copyright owner, as is the case for works whose term of copyright protection has expired, or those which never qualified for copyright protection in the first place. I use the term in a broader sense, extending to *particular uses* of a work that are unconstrained by copyright, even if other uses are within the copyright owner's control.

[44] *See supra* notes 35-37, which enumerate limitations on the exclusive rights of the copyright owner.

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

[46] *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 non-commercial purposes in the home is a fair use.

[47] *See* Nimmer, *A Riff, supra* note 4, at 713.

fees for a particular use tends to lead courts to a determination that such uses are not within fair use.[48]

There are often, it is true, workarounds: the output of a CD player may be recorded using a microphone attached to a cassette recorder, and video output may be captured using a video camera pointed at the display on a television screen or computer monitor.[49] But it remains true that TPMs cut back on the scope and usefulness of the fair use limitation on the exclusive rights.

While 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 few will be able to exercise this right because the trafficking ban makes circumvention technologies hard to come by. 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," confining protection to "expression."[50] Among other things, the idea/expression dichotomy excludes protection for facts, while retaining the possibility of protection for the selection and arrangement of facts.[51] Because facts per se are not protected by copyright, neither are they protected by the anti-circumvention rules, since each of the three anti-circumvention prohibitions is limited by its terms to copyright-protected works.[52] 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.[53]

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[48] *See, e.g.*, INFORMATION INFRASTRUCTURE TASK FORCE, *supra* note 25, at 82 (discussing judicial interpretation of the fourth fair-use factor); Bell, *supra* note 4, at 567-71 (same).

[49] *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). I have used this technique myself, to record a snippet of streaming video for a child's school project. It works surprisingly well.

[50] 17 U.S.C. § 102(b) ("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 . . . .").

[51] The exclusion of facts from copyright protection is an aspect of the constitutionally mandated "originality" requirement. Feist Publications, Inc. v. Rural Telephone Service Co., 499 U.S. 340, 347-48 (1991).

[52] 17 U.S.C. § 1201(a)(1)(A) ("access to a work protected under this title"); § 1201(a)(2) (same); § 1201(b)(1) ("a right of a copyright owner under this title in a work").

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

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 70 years after the death of the author, or 95 years after publication in the case of a work made for hire.[54] TPMs, however, last forever. There is no requirement that they incorporate a mechanism that renders them ineffective after a certain date, and I am unaware of any TPM technology that includes such a feature. Deployment of TPMs thus effectively makes the duration of copyright perpetual.[55]

We should take care not to overstate the impact of this factor. The length of the copyright term, combined with the pace of technological change, means that in most cases the perpetuity of TPMs is irrelevant. By the time the term of copyright expires, 70 or 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 used to lock up a work that is near the end of its term.

B. Reduced Access to Digital 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, with a consequent reduction of 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. Neither can it be loaned, by a library to the public, or by an individual to a friend.[56] 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 onto her computer and running it.[57] Tethering TPMs are not presently used in connection

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simple databases").

[54] 17 U.S.C. § 302.

[55] *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).

[56] Library lending of software copies is not within the copyright owner's control, as an aspect of the first-sale doctrine. 17 U.S.C. § 109(b)(2)(A). Individual lending of a software copy is likewise permitted, as long as it is not done for purposes of commercial advantage. *Id*. § 109(b)(1)(A).

[57] *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 her computer. *See* John A. Rothchild, *The Incredible Shrinking First-Sale Rule: Are Software Resale Limits Lawful?*, 57 RUTGERS L. REV. — (2005).

with music CDs or movie DVDs,[58] but at some point publishers might find it expedient to implement such controls, which would make it impossible to borrow protected copies from a library or rent them from a rental service.

Resale and lending of copies containing copyrighted materials is an important means of broadening access to those materials.[59] Not everyone is able or willing to pay the full retail price for a computer program or electronic book. If a copy is available for sale on the secondary market, such potential users can become actual users.[60] Consumers with a lower level of resources or interest, who are willing to make do with temporary access, can obtain copyrighted materials at no cost through library borrowing.

Beyond tethering, the shift to a pay-per-use market for information goods might depress use of those goods. First, absent some breakthrough in the system for assessing usage fees, pay-per-use is likely to entail high transaction costs, if nothing else in terms of the time and attention that users would be required to devote to deciding whether to purchase a particular unit of content.[61] Second, if users must pay for each unit of access they will face a disincentive against perusing material that is of unknown value.

Reduced access can also result when an authorization code required to operate a computer program becomes lost or separated from the copy of the program, rendering it unusable.[62]

On the other hand, TPMs may have a countervailing effect of 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.[63] Price

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[58] Note, however, that a limited form of tethering of DVDs, region coding, is in widespread use. *See supra* text accompanying note 16.

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

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

[61] *See* Clay Shirky, *The Case Against Micropayments*, http://www.openp2p.com/pub/a/p2p/2000/12/19/micropayments.html (Dec. 19, 2000) ("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 . . . .").

[62] The exceptions to the ban on circumventing access controls that the Librarian of Congress created, discussed *supra* in note 41, allow circumvention to overcome malfunctioning *hardware*-based controls ("dongles"), but not to overcome a lost authorization code, which is *software*-based.

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

discrimination can succeed only if the publisher can prevent arbitrage, which occurs when a lower-valuing user resells the good she has purchaser to a higher-valuing user.[64] A tethering TPM can prevent arbitrage, by making an information good useless except when used by the original purchaser. However, the significance of this factor should not be overstated. First, a tethering TPM can prevent arbitrage only if 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 promotes 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, transferring it to publishers. Indeed, perfect price discrimination shifts *all* of the surplus to publishers.[65] Third, price discrimination is costly to implement, and can be accomplished only imperfectly. Sellers can never do better than a rough approximation of a consumer's valuation of the product; [66] it is costly for sellers to gather the information they need to engage in price discrimination; and it is often costly for consumers to participate in price discrimination.[67] These extra costs and mismatches between consumer valuation and 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, in the context of both information goods and ordinary manufactured goods.

Maintaining proprietary file formats. Apple Computer, Inc. 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. RealNetworks, a competitor in the market for music downloads, released software that converts music from RealNetworks' format to Apple's format, thereby allowing music purchased from RealNetworks to be

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[64] *See* Michael J. Meurer, *Price Discrimination, Personal Use and Piracy: Copyright Protection of Digital Works*, 45 BUFF. L. REV. 845, 869 (1997) (discussing arbitrage).

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

[66] *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.").

[67] 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).

played on iPods.[68] If Apple were successful in arguing that the RealNetworks software is an illegal circumvention technology, the effect would be anticompetitive.

Inhibiting reverse engineering. A software developer may find it necessary to perform analysis of computer code written by somebody else for a variety of purposes, many of which promote competition and innovation.[69] To engage in this sort of analysis, known as reverse engineering, it is necessary to gain access to the code, and generally also to copy it. If the code is protected by a TPM, gaining the necessary access may be both difficult and, because of the anti-circumvention rules, unlawful.[70] While the anti-circumvention rules contain an exception permitting reverse engineering,[71] that exception is quite narrow in scope.[72]

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.

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[68] *See* GARTNERG2 & BERKMAN CENTER FOR INTERNET & SOCIETY, COPYRIGHT AND DIGITAL MEDIA IN A POST-NAPSTER WORLD (Version 2 Updated January 2005), at 46; 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.").

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

[70] Under at least some circumstances, copying the code will be fair use, and thus neither a copyright infringement nor a violation of the anti-circumvention 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'a 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.").

[71] 17 U.S.C. § 1201(f).

[72] *See* Samuelson & Scotchmer, *supra* note 69, at 1635 n.289 (explaining that section 1201(f) is narrower than the exception recognized in *Sega v. Accolade*).

In *Sony Computer Entertainment America Inc. v. GameMasters*,[73] Sony sued the seller of a device, called the Game Enhancer, 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 be used to play games on CD-ROMs that contain a region code that ordinarily prevents 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 to be played only 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 Sony was likely to succeed in proving a violation of the section 1201(a)(2) ban on trafficking in access-circumvention devices.[74]

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 designated for distribution in the United States, and those made for distribution in Japan or Europe. But the court's rationale seems 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 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 Int'l, Inc. v. Static Control Components, Inc.*,[75] Lexmark sued a producer of computer chips that 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 it 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, that contains the same code as in the chips that Lexmark installs in its toner cartridges. It sells the chips to third parties that remanufacture toner cartridges that Lexmark has designated to be used once and returned to it. The SMARTEK chip allows these remanufactured cartridges to provide the requisite authentication sequence to the Printer Engine Program, and therefore be usable in a Lexmark printer. Lexmark argued that the SMARTEK chip was a device designed to circumvent the authentication sequence, which it characterized as a technological measure that effectively controls access to the Printer Engine Program and to the code in the toner cartridge chip. The

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[73] 87 F. Supp. 2d 976, 981 (N.D. Cal. 1999).

[74] *Id*. at 987.

[75] 387 F.3d 522 (6th Cir. 2004).

district court agreed, and granted Lexmark a preliminary injunction, finding it was likely to succeed in proving that in manufacturing the SMARTEK chip Static Control violated the section 1201(a)(2) ban on trafficking in devices that circumvent access controls.

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 was freely accessible to anyone in possession of the printer: it was not encrypted, and could be read directly from the printer's memory. 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.[76]

This rationale would appear to be subject to easy evasion by a manufacturer that wished to use the anti-circumvention rules to prevent interoperability with a competitor's products. It would be simple enough for Lexmark to encrypt the Printer Engine Program, and include within the toner cartridge chip the key needed to unlock it. Yet other language in the court's opinion suggests a broader rejection of the invocation of section 1201 for anti-competitive purposes. The court draws 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 upon the human senses. The court seems to indicate that only the latter sort of copyrighted expression is entitled to the protection of the anti-circumvention rules.[77] In addition, a concurring judge explicitly declines to accept an interpretation of section 1201 that would aid a manufacturer in suppressing competition.[78]

In *Chamberlain Group, Inc. v. Skylink Technologies, Inc.*,[79] plaintiff Chamberlain, a manufacturer of garage door openers, invoked section 1201 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 the string of bits received from a transmitter. The string that is transmitted, called a "rolling code," changes each time the transmitter's button is pressed. The program in the opener activates the motor that opens the door only if the code it receives from a transmitter satisfies a set of criteria generated by an algorithm.

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[76] *Id*. at 547.

[77] *Id*. at 548.

[78] *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.").

[79] 381 F.3d 1178 (Fed. Cir. 2004).

According to Chamberlain, the algorithm is designed to thwart potential burglars, who would capture the string as it is emitted from a transmitter and 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, emitting 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 controls access to the computer program, and therefore violates 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. It 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. Moreover, there can be no violation of the anti-trafficking provision in the absence of an actual act of circumvention of an access control.[80] 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.[81]

In adopting this narrow reading of the trafficking ban, the court was self-consciously avoiding an alternative interpretation 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 . . . .[82]

The court's interpretation of section 1201 thus recognizes its potential use as a tool to suppress competition, and seeks to avert that outcome by a narrowing construction. It remains to be seen, however, whether this construction will have staying power. The requirement that the breach of an access control result in actual infringement does not appear on the face of the statute; nor does the rule that there can be no violation of the trafficking ban absent an act of circumvention. 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."[83]

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

[81] *Id*. at 1203.

[82] *Id*. at 1201.

[83] 17 U.S.C. § 1201(b)(1)(A), (B), & (C).

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.[84]

D. Privacy

TPMs can be implemented in ways that invade the privacy of users of the protected content.[85] This may come about when a publisher grants access to content protected by a TPM only if the user agrees to divulge personal information.[86] Some TPMs are implemented using a globally unique identifier, which permits publishers to track users' preferences — information that publishers may find useful as a means of implementing price discrimination.[87] Copyright management information systems, an adjunct to TPMs, enable publishers to keep tabs on who is viewing their material.[88]

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 they encourage publishers to make works available in digital formats, they advance the fundamental goal of copyright in promoting access to creative output. On the other hand, TPMs impose costs on society to the extent they entail contraction of the public domain, elimination of the secondary market, interference with competition, and intrusion on privacy.

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[84] For discussion of additional contexts in which TPMs might be used to suppress competition, see Dan L. Burk, *Anticircumvention Misuse*, 50 UCLA L. REV. 1095, 1110-14 (2003).

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

[86] *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"); In the Matter of Digital Entertainment and Rights Management, Before the Technology Administration, Department of Commerce (July 17, 2002) (Comments of the Electronic Privacy Information Center) ("In an attempt to secure content, many DRM systems require the user to identify and authenticate a right of access to the protected media."), *available at* http://www.epic.org/privacy/drm/tadrmcomments7.17.02.html.

[87] *See* Jonathan Weinberg, *Hardware-Based ID, Rights Management, and Trusted Systems*, 52 STAN. L. REV. 1251, 1269 (2000) (characterizing hardware-ID-based TPMs as "pernicious from a privacy perspective"). On price discrimination, see *supra* text accompanying note [*60].

[88] *See* Pamela Samuelson, *The Copyright Grab*, WIRED, Jan. 1996, at — (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").

Since TPMs are a mixed blessing, the optimal level of their deployment, from society's standpoint, is probably something less than 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 consumers to express their preferences so as to bring about an allocation of resources that economics characterizes as "efficient." 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* to implement. The standard tools of economic analysis are available for this purpose. Starting out with a set of assumptions about the number of sellers in a market, the number of buyers, the substitutability of different goods in a market, 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, economics posits that a rational producer will offer goods in a certain quantity, at a certain price.

Since the addition of a TPM to an information good makes that product less desirable to buyers, it is tempting to model addition of a TPM as the equivalent of a price rise. This would be a mistake, as 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 her car CD player or to give to a friend, and who does not plan to extract tracks to make a mix CD, would not reckon the value of the CD as less if an anti-copy measure is added. A user of DVDs who does not travel overseas may not care a fig about region coding. If the TPM consists of a tethering restriction, and a consumer has no interest in using the software or listening to the song on more than one device, she will not consider the restriction 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 rise, and that all prospective purchasers have a reservation price. Under that assumption, any price rise will alienate the marginal purchaser. By contrast, addition of TPMs will not necessarily have that effect. Within a particular range, 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. 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 brings about increased demand for it. If an anti-copy measure prevents a

buyer from making a copy and giving it to a friend, or a tethering measure presents her from disposing of it in the secondary market, the producer may make an additional sale.[89] 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 net effect on the demand for the product is the difference between these two effects. By contrast, the effect of a price rise is unambiguously to depress demand.[90]

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[91] has the effect of lowering manufacturing costs, through substitution of cheaper materials or a cheaper manufacturing process. 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 generate consumer complaints, which cost money to deal with.[92] 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.[93] But, as

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[89] 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 10-20 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, Sec. 3 at 4.

[90] This is true for "ordinary goods," but not for the rarely encountered (except in economics textbooks) "Giffen goods." *See* VARIAN, *supra* note 65, at 104-05.

[91] It is conceivable a producer might find it expedient to accept increased manufacturing costs as the condition to receiving the benefits of planned obsolescence.

[92] *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 — (reporting that in the mid-1980s, one software industry representative member stated that "20% to 25% of the industry's service calls are related to problems caused by copy protection").

[93] 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. That will tend to increase demand for the new items. For analysis of a firm's output and pricing decisions with respect to durable goods, taking into account the secondary market, 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,

explained above, addition of a TPM may shift the demand curve in either direction, or not at all.

Addition of TPMs thus generates a set of tradeoffs for the publisher that differ from those facing a producer 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.

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

1. The TPMs incorporated in an information good can be quantified according to some metric. That metric, which for present purposes need not be specified, must correlate with how restrictive users of the good perceive the TPM to be.[94]

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

3. Publishers incorporate in 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 implementation of a TPM, through alienation of existing customers, which I refer to as "alienated demand" or AD;[95] (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,

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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).

[94] 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 limits to three the number of devices on which an MP3 file may be played 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, encumbered with different combinations of TPMs. The metric orders the TPMs according to the size of the bids they draw.

[95] 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 though an unauthorized copy or distribution, and might as a result become a paying customer — as when one becomes acquainted with new music through an unauthorized download of an MP3 file, and then buys a CD; or 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.

which I call "recovered demand" or RD;[96] and (3) the cost to the publisher 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 it sells, the price per unit it receives, and its costs: $\Pi = \Pi(q, p, c)$. Its profit in Period 0 is thus

$$\Pi_0 = \Pi(q_0, p, c_0).$$[97]

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. 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 Π_1, we set $\Pi_1' = 0$. Then we have

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

In taking the derivative, Π_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

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

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[96] 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 protects. Furthermore, as discussed above, in Part III(B), TPMs may facilitate price discrimination, enabling the publisher to appropriate more of the surplus. To the extent these effects exists, the publisher's incentive to implement the TPM is increased, beyond the TPM's effect in increasing RD. For simplicity, we may incorporate this effect into the **RD** curve.

[97] To simplify matters I assume that price remains constant from Period 0 to Period 1. This will not necessarily be the case. If demand for the good shifts due to implementation of TPMs, a profit-maximizing publisher may change the price.

This is the same 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*.

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 for the product on the part of *existing buyers* changes as TPMs are added to the product in increasing quantity. The intersection of curve **AD** with the horizontal axis shows the quantity demanded when no TPM is used. Moving along this curve to the left, TPMs are introduced to the product in increasing quantity, causing increasing number of buyers to defect, and therefore depressing demand. At its left end, curve **AD** may turn vertical, if all remaining buyers are indifferent to the addition of more TPMs, or it may intersect the vertical axis, if the TPMs become so onerous that all buyers 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.[98]

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 defecting buyers, and the *increase* in demand resulting from conversion of would-be sharers, now thwarted by the presence of TPMs, into paying customers.

[98] It is possible that at high levels of TPMs the **RD** curve will go past vertical and take on a negative slope, angling back towards the vertical axis. This would occur if adding TPMs becomes counterproductive because some potential buyers who were induced to buy at lower levels of TPM become alienated and defect at higher levels. To simplify the analysis, I assume that within the range of TPMs applied the slope of the **RD** curve remains positive (or infinite, if it turns vertical).

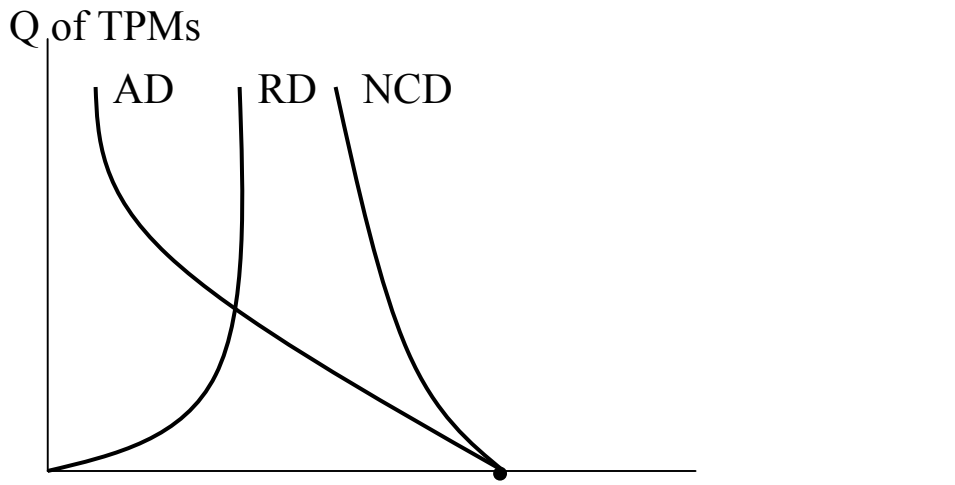

Figure 1

As depicted in Figure 1, curve **NCD** intersects **AD** at the horizontal axis, and slopes upward to the left. This shows that the net effect of adding TPMs is a reduction in demand. This is not the inevitable shape of curve **NCD**. That 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 addition of the TPMs results in alienating more existing buyers than attracting new buyers.

Figure 2 diagrams the opposite assumption. Curve **RD** remains as in Figure 1, but curve **AD** is drawn more closely vertical, indicating that existing buyers are bothered only slightly by the addition of TPMs. As a result, summing these two curves yields a curve **NCD** that slopes up and to the *right*, indicating that 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 buyers.

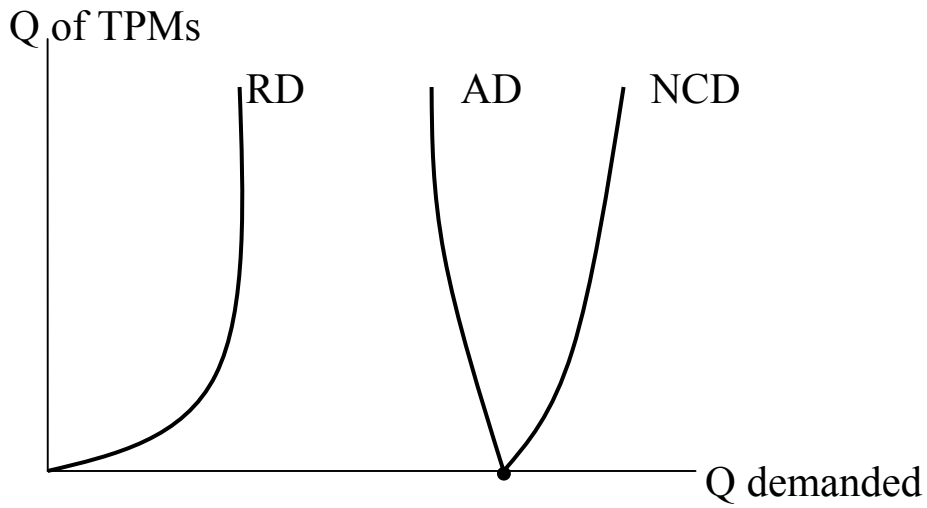

Figure 2

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

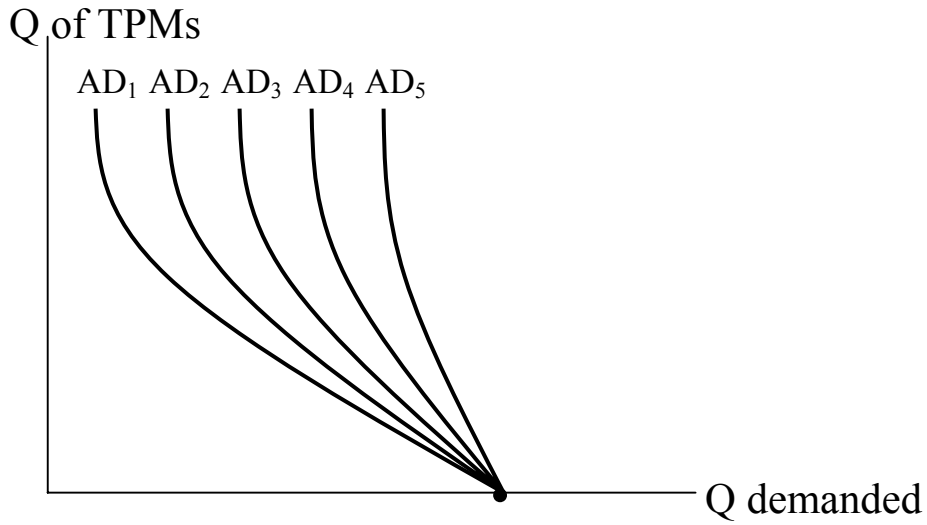

Figure 3

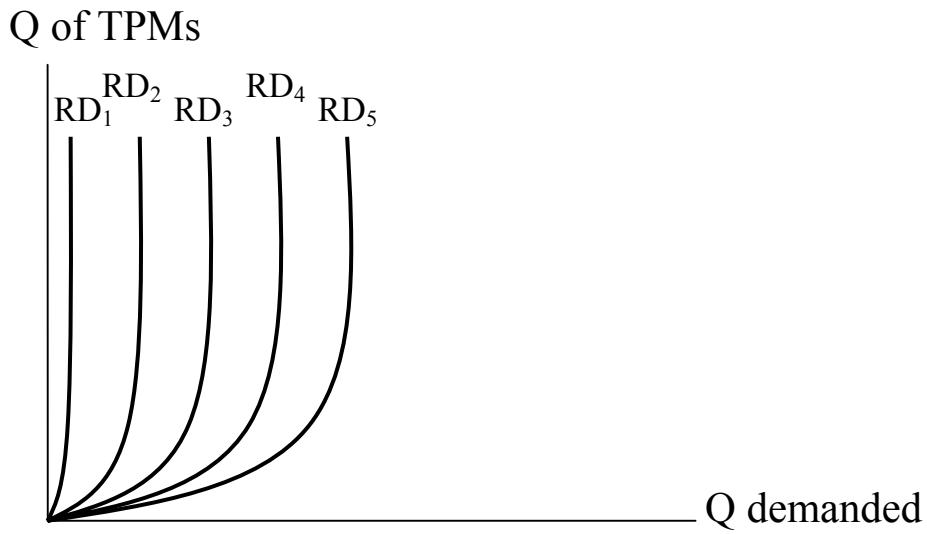

Figure 4

By mixing and matching these **AD$_i$** and **RD$_i$** curves, we get a family of corresponding **NCD$_i$** curves, as in Figure 5.

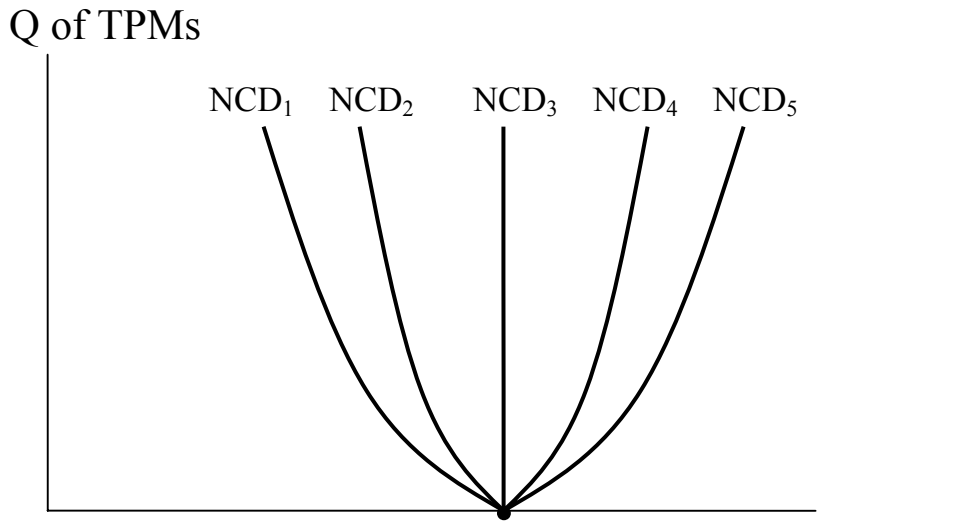

Figure 5

Curve **NCD$_1$** would result from combining something like **RD$_1$** with **AD$_1$**; curve **NCD$_5$** would come from a combination of **RD$_5$** with **AD$_5$**; etc.

The possibility that there are NCD curves shaped like **NCD_4** and **NCD_5** demonstrates why the addition of TPMs cannot realistically be modeled as a price increase. These represent upward-sloping demand curves, a species not observed in the neoclassical world of microeconomic theory.

The RD curve resulting from a particular TPM may not be independent of the AD curve associated with the same TPM on the same product. It might be, for example, that buyers of an information good dislike a TPM just to the extent that it is effective in reducing unauthorized use. Then we would expect that a product-TPM combination with an AD curve like **AD_1** would have an RD curve like **RD_5**. To the extent there is such a correlation, we would not expect to find combinations like **RD_1** with **AD_5** or **RD_5** 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.

The next step in the analysis is to derive the marginal revenue curve associated with each product-TPM combination. Commonly in economic analysis a marginal revenue curve shows the change in revenue resulting from a change in *price or output* of a product. In the current context, 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.[99] Since we have a family of NCD curves, we will correspondingly have a family of MR curves, 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 each TPM quantity. 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 adding 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 quantity demanded decreasing as TPMs are added, **MR_1** remains in negative territory, until intersecting the horizontal axis at the point where **NCD_1** turns vertical. Curve **MR_3**, corresponding to **NCD_3**, is depicted at a constant value of zero, since the infinite slope of **NCD_3** shows that quantity demanded is insensitive to the quantity of TPMs.

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[99] 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.

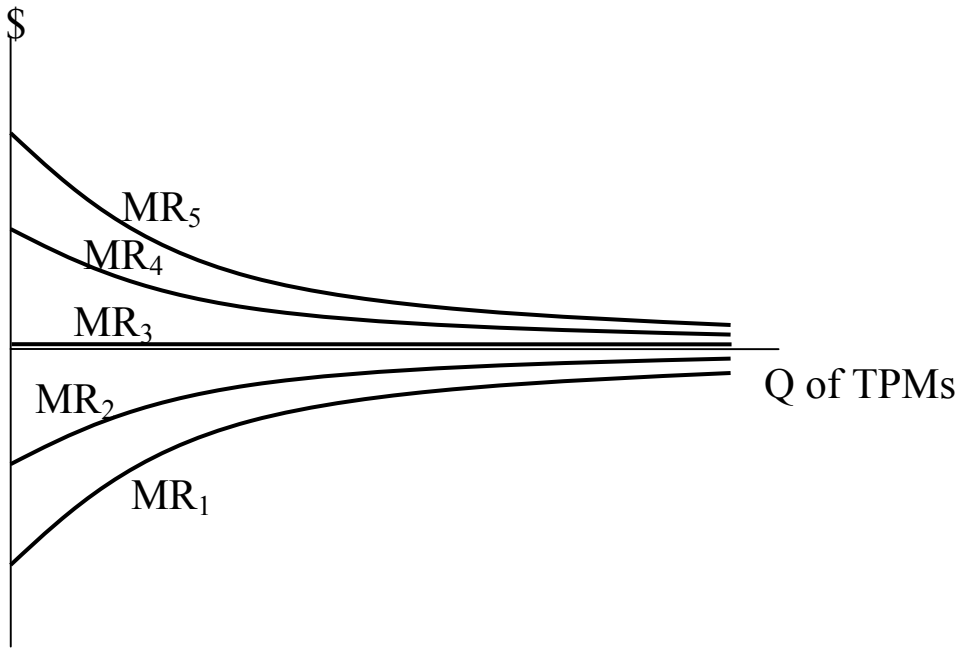

Figure 6

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 price, which is marginal revenue.[100]

[100] *See* EATON & EATON, *supra* note 99, at 262 (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").

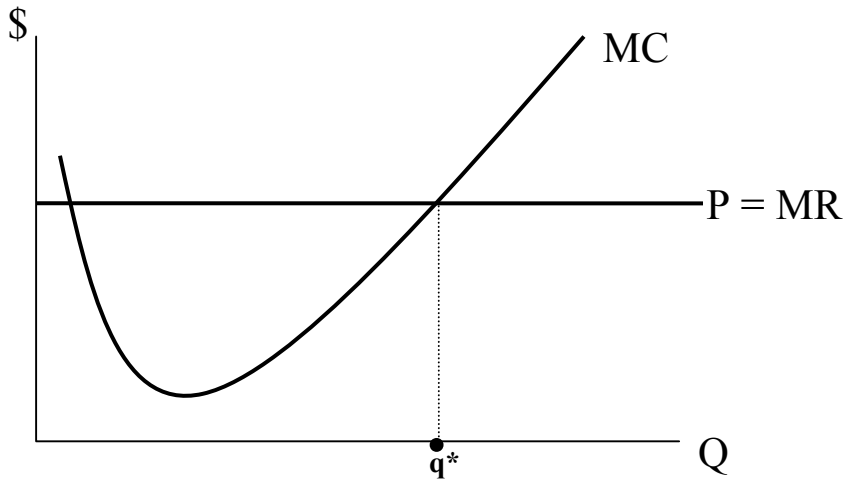

Figure 7

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 increase 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, occurring at the quantity where marginal cost equals price.

This standard depiction of a marginal cost curve cannot be imported into the present context. There is a crucial difference. In the standard account, cost is graphed against the *quantity of output of a good*, with scale economies and diseconomies resulting 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 in 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. 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 $\Delta MR - C$, with C representing the cost of implementing the TPM, assuming that $\Delta MR > 0$.[101] The TPM that maximizes this value will not necessarily be the cheapest to use. It might be that a relatively expensive TPM is the most effective at thwarting would-be unauthorized users, and is also well designed so as to minimize the inconvenience it creates for the user.

[101] As we are about to see, if $\Delta MR < 0$ the publisher will not implement any TPM.

Therefore, the publisher's marginal cost curve can take a variety of shapes. All we can say for sure is that the curve lies always above the horizontal axis, since TPMs do 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.

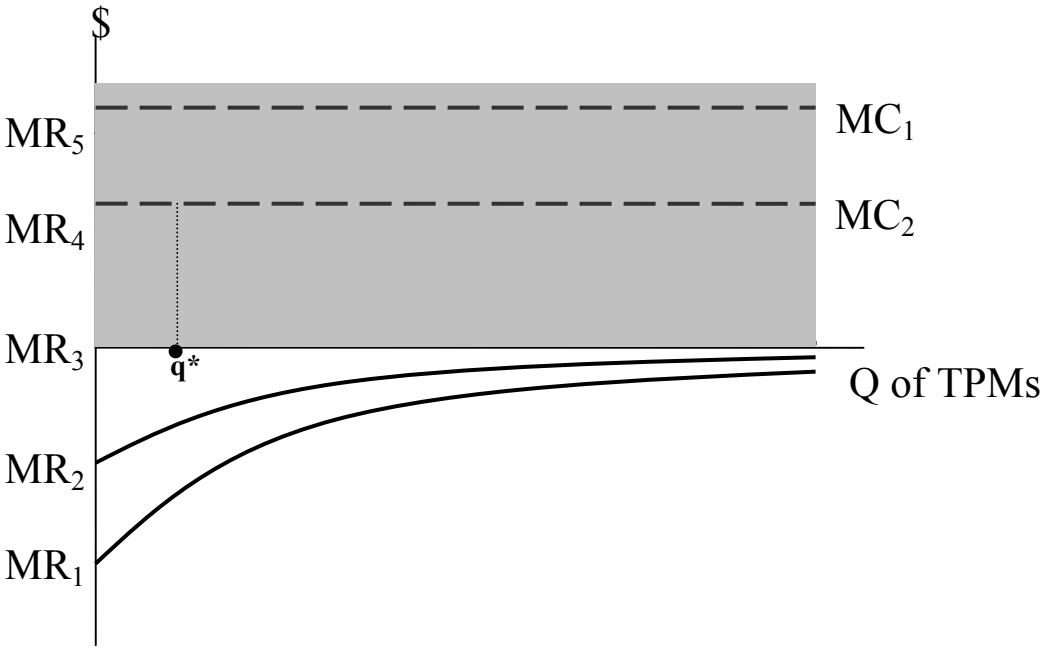

Figure 8

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 there is no cost-effective TPM available. Every 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 **MC_2** lies above some of the MR curves, but intersects others. Thus, if the MR curve applying to a particular product is **MR_5**, and the applicable MC curve is **MC_2**, then the publisher maximizes profits by implementing the quantity of TPMs indicated by point **q***.[102] If, however, the applicable MR curve is **MR_4**, no TPMs will be implemented.

[102] If the MC curve is not monotonic, it might intersect a MR curve at more than one point. This would make it more difficult to determine the level of TPMs that maximizes profits, since 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.

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 the level of TPMs such that marginal revenue with respect to quantity of TPMs equals marginal cost of adding TPMs. The marginal revenue curve may assume any of a variety of shapes. If the relevant MR curve lies always 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.[103] There is a kernel of truth to this, but the full truth is more complicated.[104] No 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 upon 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 conditions of near-perfect (or at least robust) competition, varying strengths of monopolistic competition, 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:[105] (1) The number of buyers and sellers 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 to entry to or

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

[104] *See* Boyle, *supra* note 6, at 2018 ("The question of whether a monopoly exists is one that is determined by the availability of substitute goods, not the shape of the legal entitlement."); Margaret Jane Radin, *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.").

[105] *See* CARLTON & PERLOFF, *supra* note 93, at 57-58; SCHERER & ROSS, *supra* note 67, at 17-18.

exit from the market. (3) Buyers and sellers possess all relevant information about the market. (4) There are no externalities.[106]

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 many buyers. We might reasonably posit that, for a large segment of the consuming public, one such movie is a close substitute for another. There may be exceptions — there may be films featuring certain stars that set them apart from the generic pornographic movie — and if so, such movies would define a separate market. Under these conditions, no individual seller of movies has any market power.[107] If one seller raises its price, it will experience a significant loss of sales, as buyers choose other movies that are just as desirable but are cheaper. (If the market structure was truly one of perfect competition, a seller that raises its price would see its sales drop to zero.)

Another plausible example in the same mold is recordings of classical music by undistinguished orchestras. 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 stock fewer copies of videotapes, in favor of DVDs; record stores carry mostly CDs, few cassettes, and no DAT or vinyl phonograph records — and diversity is replaced by monoculture.[108]

With the competitive market as the baseline, we can proceed to consider how other market structures affect the responsiveness of publishers to consumer preferences in their decisions whether to implement TPMs.

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[106] Elsewhere I address the problem of externalities resulting from the use of TPMs. *See* [forthcoming].

[107] *See* CARLTON & PERLOFF, *supra* note 93, 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*.").

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

B. Monopoly

As observed above, there is a kernel of truth in the common characterization of copyright as conferring a monopoly, deriving from the fact that a copyright owner has a legal right to prevent anyone else from making available in the marketplace a work that is identical, or substantially similar, to her own work.[109] This results in what may be called monopoly in common parlance, but more is required for there to be monopoly in the economic sense.

For the economist, monopoly describes a situation in which a seller offers a product for which there are no close substitutes.[110] The lack of close substitutes gives the seller market power: it can raise price above marginal cost, without seeing sales go to zero, as they would 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 purchase because the price exceeds the value they place upon it. This is reflected in the downward-sloping demand curve that is conventionally used to represent the behavior of monopolists.[111]

The absence of close substitutes means that the monopolist need not be as responsive to consumer preferences as must a participant in a competitive market. 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 customers to competitors; this is true by definition, there being no close substitutes. The same reasoning holds true for product characteristics: minor reductions in the desirability of product characteristics will not result in the loss of many customers, though major ones might.

Some publishers of information goods occupy a position that could be reasonably characterized as monopolistic.[112] One example is publishers of computer operating systems. An operating system has no close substitutes because, due to software and hardware incompatibilities and other switching costs, the costs of switching to a different

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

[110] *See* EATON & EATON, *supra* note 99, 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 is assessing compliance with the Sherman Act — is a bit different. "Monopoly power" under that 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).

[111] *See* CARLTON & PERLOFF, *supra* note 93, at 87 ("A monopoly faces a downward-sloping demand curve and sets a price above marginal cost.").

[112] Whether a particular market participant is a monopolist is a constestable issue. *See* EATON & EATON, *supra* note 99, at 286 ("The definition of monopoly is unavoidably ambiguous because we can't define 'close substitute' with perfect precision.").

operating system are very large.[113] Microsoft has been adjudged a monopolist in the market for Intel-compatible personal computers, with respect to its Windows operating system,[114] and Apple is just as much a monopolist in the market for Macintosh-compatible operating systems. A seller of the Linux operating system is not a monopolist, however, since as an open-source product anyone who wishes can sell it competitively (including competing with free).

The publisher of a book that defines its own genre might be considered a monopolist. 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 struggle against the forces of evil. If the publisher raised the price of the book, it would lose sales, but that is true of any monopolist. The only substitutes for purchase of the book involve waiting: borrowing the book from the library or a friend, buying the paperback edition, buying a used copy, or maybe seeing the movie. These are imperfect substitutes. The delay in gratification, the used condition or temporary availability of the book, transaction costs in locating a used book, etc. are product characteristics that will be relevant to some subset of potential buyers. The secondary market constrains the market power of the publisher, but only to a limited extent.[115]

The same might be said of Bill Clinton's biography, and one-of-a-kind movies, musical recordings, or works of art.[116]

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[113] *See* United States v. Microsoft Corp., 253 F.3d 34, 52 (D.C. Cir. 2001) (en banc) (referencing 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.").

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

[115] In the *Alcoa* case, United States v. Aluminum Co. of America, 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* Peter L. Swan, *Alcoa: The Influence of Recycling on Monopoly Power*, 88 J. POL. ECON. 76 (1980); Darius W. Gaskins, Jr., *Alcoa Revisited: The Welfare Implications of a Secondhand Market*, 7 J. ECON. THEORY 254 (1974). However, more generally 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).

[116] 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 of 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 Associates, Inc. v. Shubert Organization, 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.");

Under the standard analysis, a monopolist that is unable to price-discriminate will raise its price and reduce its output, in comparison to a competitive supplier, and in so doing will realize monopoly rents while imposing a deadweight loss on society.[117] The analysis applied to monopolists fundamentally differs from that applied to pure competitors. Because under pure competition each producer 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 price. But a monopolist can set its own price, and so must consider both its production function and the shape of the demand curve it faces.

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

Let us go back to Figure 1, and consider the shape of the **AD** curve. Under competitive conditions, introduction of TPMs causes a relatively rapid dropoff in demand, as buyers who are sensitive to TPMs defect in favor of close substitutes. If the product has no close substitutes, we would expect the rate of defection to be less. Just as a monopolist suffers less of a reduction in demand from a price rise than does a seller in a competitive market, so the monopolist suffers less of a dropoff than does a pure competitor when it adds TPMs.

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 to control its Windows software with the release of Windows XP in August 2001. Product activation usually proceeds transparently, but it can be a hassle to re-activate Windows if the user changes the hardware components of her computer or reformats the hard drive.[118] Some commentators predicted substantial

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Lynch Business Machines, Inc. v. A.B. Dick Co., 594 F. Supp. 59, 66 (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."). Others 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 Broadcasting System, 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.").

It remains the case, however, 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.

[117] *See* CARLTON & PERLOFF, *supra* note 93, at 88-94.

[118] *See* Microsoft, *Windows XP Product Activation*,

consumer resistance to the new activation requirement,[119] but it does not seem to have occurred.[120] This is hardly surprising: switching from Windows to the Mac OS or Linux requires incurring massive costs to purchase new software and (for Mac) hardware, reinstall and reconfigure, learn how to use the new system, etc. 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 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).

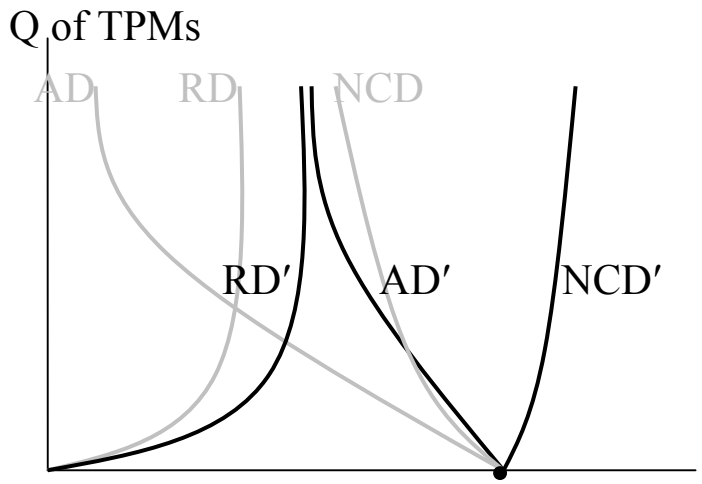

Figure 9

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www.microsoft.com/windowsxp/evaluation/features/activation.mspx (Aug. 29, 2002) ("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.").

[119] *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.").

[120] *See* WindowsIT Pro, *OS Market Share: Microsoft Stomps the Competition*, 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 . . . .").

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 demand for the product through unauthorized methods that do not result in compensation to the publisher (such as borrowing a copy from a friend or a library, receiving an unauthorized copy, or buying a used copy on the secondary market), and whose demand for the product is sufficient that they will continue using it even after implementation of TPMs requires them to do so on the publisher's terms. In a competitive market, the user who due to the implementation of TPMs is unable to continue making unauthorized use of the product has two options: he can pay the publisher for authorized use of the product, or he can switch to another product that is a close substitute and is not protected by TPMs. In a monopolized 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 more 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 form part of the first publisher's recovered demand. But a consumer who has been in the habit of installing his 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 will therefore represent recovered demand for Microsoft. Figure 9 depicts **RD** under competition (gray) with **RD′** under monopoly (black).

Since both the **AD** and the **RD** curves lean more to the right under monopoly 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, as compared to 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 (showing 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.

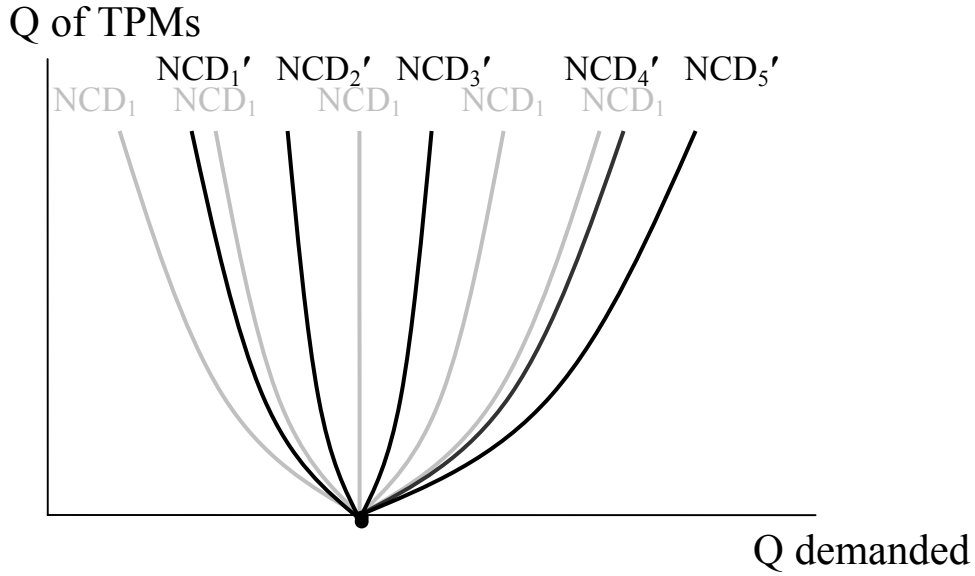

Figure 10

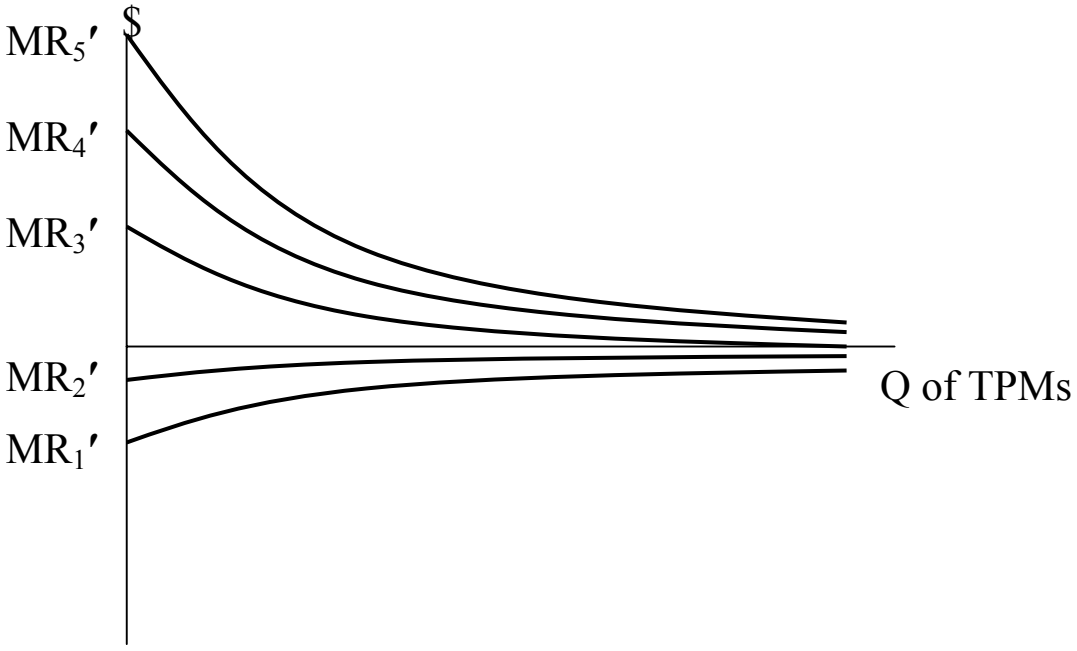

Figure 11

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 implement TPMs if the benefit it expects in terms of additional sales due to reduced unauthorized use exceeds the costs it expects to incur, consisting of lost

sales due to alienating current customers and the costs of implementing TPMs. The analysis simply means that, all else being equal, a publisher is more likely to implement TPMs in a product to the extent the product has no close substitutes. This result accords with the intuition that a monopolist need be less responsive to consumer preferences than a seller in a competitive market.

The 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. In between 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 possesses unique characteristics. Although each product is unique, there are other unique goods in the market that are fairly close substitutes. The substitute products are different enough from each other that sellers 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. Monopolistic competitors thus face a downward-sloping demand curve, rather than the horizontal curve faced by the seller in a competitive market; but the slope of the curve is smaller (slope is closer to zero) than the slope of 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.[121]

Whether one product is differentiated from another depends entirely on consumer perception. Thus, if two products are objectively indistinguishable, but consumers perceive them as having different characteristics, say 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.[122]

The standard economic analysis of monopolistic competition resembles that of monopoly in some respects, and that of perfect competition in others. In long-run

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[121] *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.").

[122] *See* EDGAR K. BROWNING & MARK A. ZUPAN, MICROECONOMICS: THEORY AND APPLICATIONS 356 (8th ed. 2003).

equilibrium, sellers in monopolistic competition can earn no monopoly rents. If one seller is making economic profits in the short run, that will induce entry by new market participants, supplying products that are closer substitutes for the first seller's products than are existing products in the market, and driving price down to the competitive level. However, since with a downward-sloping demand curve marginal revenue is less than price, the equilibrium price will be more than marginal cost, resulting in deadweight loss, although less than in the case of monopoly.[123]

Most information goods are offered in markets that are monopolistically competitive. Copyright assures that each product will be unique. Occasionally, as discussed above, these unique goods will have such close substitutes that sellers 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 intermediate between these extremes. Novels, movies, paintings, recordings of country music and opera stars, and textbooks are all unique, but most have reasonably close substitutes, such that if the producer raised its price substantially, a substantial 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 markets. The closer are the substitute products, the more the demand curves will resemble those of a competitive market; the more distant the substitutes, the more like 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 products might decide to implement TPMs with some, 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, producers might make a single decision whether to apply TPMs to the entire range of their 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 producers 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.

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[123] *See* BROWNING & ZUPAN, *supra* note 122, at 357-60; SCHERER & ROSS, *supra* note 67, at 21-22.

Oligopoly is defined by a market structure in which there are few sellers (but more than one), and substantial barriers to entry.[124] The most significant difference between oligopoly on the one hand, and competition and monopoly on the other, from the standpoint of modeling a firm's optimization decisions, is that under oligopoly each producer must take into account the anticipated and actual actions of rival producers.[125] In a competitive market, each producer is small relative to the size of the market, and 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 with, within a broad range of pricing options (though at some elevated price the monopolist must worry about the actions of producers offering distant substitutes).[126]

For this reason, economists find it more difficult to predict firm behavior under oligopoly than under either monopoly or competition. Various models are used, differing in their assumptions about the extent to which firms manage to cooperate. Collusion among oligopolists results in a combination that behaves like a single monopolist. Noncooperative behavior leads to outcomes closer to the competitive ideal as the number of rival firms increases, and to Prisoner's-Dilemma-style situations in which each firm may follow a dominant strategy that fails to maximize its profits.[127]

What these oligopoly models have in common derives from the dynamics of 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 rise (or, conversely, a price drop) depends on the relative magnitudes of these two effects. But 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. 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. The 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 supra-competitive level, formation of a cartel that raises price to the monopoly level, or unpredictable oscillation.[128]

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[124] *See* CARLTON & PERLOFF, *supra* note 93, at 7; SCHERER & ROSS, *supra* note 67, at 17-18.

[125] *See* SCHERER & ROSS, *supra* note 67, at 200 ("The basic difficulty facing an oligopolist is uncertainty about rival actions and reactions.").

[126] *See* CARLTON & PERLOFF, *supra* note 93, at 153.

[127] *See* CARLTON & PERLOFF, *supra* note 93, at 153-86; SCHERER & ROSS, *supra* note 67, at 199-226.

[128] *See* SCHERER & ROSS, *supra* note 67, at 199-208.

The market for recorded music presents an oligopolistic market structure. In 2003, the five big record labels accounted for about 75 percent of the industry worldwide.[129] In August 2004, two of the majors, Sony and BMG, merged their operations in all markets except Japan,[130] so now the bulk of the industry is controlled by four firms. While the record labels may 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, or across an entire genre, or within an entire geographic market. Thus, Sony (Japan) announced a decision to eliminate TPMs from all CDs released in the Japanese market.[131]

As we saw above, introduction of TPMs cannot usefully be modeled as a price rise, 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, which in 2004 captured 29.6 percent of the U.S. market for recorded 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. 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. Based on this research, Universal determines that the benefits (to it) of adding copy protection will outweigh the costs, and so decides to implement this TPM.

Now consider how Universal's move affects its rival Sony BMG, with a 28.5 percent market share. Before Universal's move, Sony BMG had done its own research, and concluded that adding copy protection would produce a net detriment.[132] 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 longer offer the advantage of free copyability. Some of those customers may still defect to a less-close 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

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[129] *See Global Music Sales Down 7.6 Percent Last Year*, SAN JOSE MERCURY NEWS, Sept. 13, 2004.

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

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

[132] 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 producers.

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 now 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 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 customers of Universal 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 defections of their customers 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. Go back to our initial hypothetical, in which Universal was deciding whether to implement TPMs. Suppose that its calculations led it to conclude that if it alone implemented copy controls the net impact on it would be negative, since many of its customers would defect to other labels. Looking ahead one move, Universal might recognize that once it makes its move, it will become rational for one or more of its rivals to respond by adding copy controls, which will have a positive effect on Universal's demand. Universal might thus implement TPMs in the expectation that its rivals will follow suit.

Oligopolistic market conditions may give impetus to an industry-wide shift towards 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 the consumer experiences the phenomenon on a dozen different movies she 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 thus 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

whether the market in which the publisher acts is characterized by competition, monopoly, monopolistic competition, or oligopoly. The more competition there is, 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 upon 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 upon 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 conditions. For a publisher to determine whether implementing TPMs will promote its interests, and thereby to be responsive to consumer preferences, the publisher must take these conditions into account.

We have already identified two of the factors that go into determining the shape of these curves: 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 of TPMs have been successful, while 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 cost-of-TPM 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. As is often the case with economic modeling, however, while a model can help us recognize how various factors affect the incentives facing economic agents, 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-copying technology.[133] They adopted this strategy based on their perception that users of their software were engaging in widespread

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

unauthorized copying of it, allowing others to make use of the software without paying for it.[134]

By 1987 or so, virtually all software publishers had discontinued the use of anti-copying technology. The software publishers' decision to eliminate copy protection has been commonly explained as a response to consumer resistance,[135] and to the ease with which the technology could be circumvented.[136] Users of the software, particularly institutional customers,[137] 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.[138] Getting "permission" from the software publisher to make a copy for such a purpose could be an arduous undertaking.[139]

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[134] *See* Carroll, *supra* note 92, at — (citing "industry estimates that as many as half the programs in use on microcomputers were illegal copies").

[135] *See* 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."); 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."); 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."); David M. Hornik, Note, *Combating Software Piracy: The Softlifting Problem*, 7 HARV. J.L. & TECH. 377, 414 (1994) ("copy protection annoyed legitimate users by interfering with necessary computer functions, such as hard drive installation or data backup"); STEWART BRAND, THE MEDIA LAB 202 (explaining that software publishers "were forced to drop copy protection schemes . . . because non-copy-protected competitors were grabbing the market"); T.R. Reid, *Consumers Win as More Software Firms End Copy Protection*, WASH. POST, Nov. 10, 1986, at F13 ("customers . . . simply refused to buy copy-protected software whenever there was a halfway decent alternative"); Carroll, *supra* note 92, at — (quoting Microsoft chairman Bill Gates as declaring "The consumer won."); 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.").

[136] *See* Kory D. Christensen, Note, *Fighting Software Piracy in Cyberspace: Legal and Technological Solutions*, 28 LAW & POL'Y INT'L BUS. 435, 467 (1997) ("publishers learned that every copy protection scheme, no matter how sophisticated, was eventually 'cracked' (or defeated) by an equally clever hacker"); Hornik, *supra* note 135, at 414 ("copy protection proved too easy to circumvent; programs quickly emerged that cracked the copy codes, making it possible to copy at will").

[137] *See* Philip Elmer-DeWitt, *supra* note 133, at 86 (the Department of Defense "banned the purchase of any protected programs for DOD use").

[138] *See* Reid, *Consumers Win*, *supra* note 135, at F13 ("it is only prudent—indeed, essential—for any personal computer user to make a copy or two of every new program purchased"); Carroll, *supra* note 92, at — ("the protection devices make it difficult to copy the programs for legitimate reasons").

[139] *See* Carroll, *supra* note 92, at — (describing the steps a user must go through to obtain a new diskette from the publisher).

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 55 percent price differential, the unprotected version outsold the protected version by a five-to-one margin.[140]

In a 1998 piece, Julie Cohen presciently suggested that the declaration of consumer victory over copy protection was premature.[141] 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 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.[142] 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.[143] This tethering technology eliminates some of the problems with 1980s copy-protection schemes: it does not interfere with making a backup copy, or installing the program on the hard drive, and is not prone to cause system crashes. Product activation has its own usability problems, however.[144]

TPMs for software thus appear to be making a comeback. But before hailing the triumph of the counter-revolution, 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 it decided to implement the measure because it was suffering a high level of "pass-along piracy":[145] it sold 7.5 million copies, which were used to file 15 million tax returns.[146] The tethering technology allowed TurboTax to be installed and operated on more than one computer, but the program would print or file the completed tax return only from the machine on which it was activated.

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[140] *See* Carroll, *supra* note 92, at —; BRAND, *supra* note 135, at 202.

[141] *See* Cohen, *Lochner*, *supra* note 6, at 523-26.

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

[143] *See* Philip Michaels, *Activation Nation*, MACWORLD, June 2004, at 20.

[144] *See supra* note 118.

[145] David Becker, *Intuit Offers TurboTax Tests, Apologies*, C|NET, Feb. 24, 2003, news.com.com/Intuit+offers+TurboTax+tests%2C+apologies/2100-1040_3-985648.html.

[146] *See* Andrew Ratner, *TurboTax Software Fuels Indignation from E-Filers*, BALTIMORE SUN, Mar. 9, 2003, at 1D.

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 of the product activation requirement "emphatically recommend[ed]" that consumers purchase a competing product, H&R Block's TaxCut, instead.[147] Users complained that the tethering measure could be troublesome if they got a new computer after installing the program on an old one,[148] and some swore off TurboTax.[149] H&R Block capitalized on the bad publicity by launching a campaign to lure TurboTax users to switch to TaxCut, which was TPM-free.[150]

Intuit responded at first by backpedaling, agreeing that its product activation measure was problematic, and saying it would use some different approach in the next year's version,[151] but within a few months it conceded defeat and announced it would abandon TPMs altogether.[152] Even more abjectly, it wrote an open letter of apology to its consumers, and published the letter in two major newspapers.[153]

Intuit's obtuse implementation of the tethering measure helped to sink it. Installation of TurboTax surreptitiously installed a program that ran in the background, monitoring the computer for use of TurboTax, and this program remained on the computer even after uninstalling 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.[154] This implementation spawned rumors that TurboTax was installing a form of spyware on the user's computer. Although Intuit denied this, the company recognized

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

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

[149] *See* Ratner, *supra* note 146, 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.").

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

[151] *See* Becker, *supra* note 145.

[152] *See Intuit Backs Down on Anti-Piracy Feature*, HOUSTON CHRONICLE, 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.").

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

[154] *See* Mossberg, *Of Top Tax Programs, supra* note 147, at B1; Becker, *supra* note 145.

that its implementation created a great deal of consumer ill-will.[155] The TPM also caused some users difficulty in installing TurboTax.[156]

Intuit's ordeal has not prevented other software publishers from implementing TPMs. 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.[157]

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

Movies on DVD, by some measures the most rapidly adopted home entertainment format in history,[158] incorporate a TPM called the Content Scramble System, which prevents the DVD's content from being accessed except on conforming playback devices, enables the publisher to prevent a user from copying a DVD using standard equipment, and allows DVDs to be coded to be playable only on machines manufactured for a particular region of the world. The DVD-Video standard also enables the publisher to incorporate User Operation Prohibition codes, which prevent the user from engaging in certain operations such as fast-forwarding.[159]

Consumer distaste for these measures is evidently robust. A hack called DeCSS, which allowed DVD movies to be decrypted and copied in degraded form onto a CD disk, has been widely available for download since late 1999, despite the efforts of movie studios to stamp it out.[160] Several companies offered software allowing CSS-encrypted DVDs to be copied, but lawsuits involving the movie studios caused the most prominent supplier of this software to shut down.[161] Probably many users 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.

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[155] *See* Hiawatha Bray, *TurboTax Feature Draws Flak*, BOSTON GLOBE, Jan. 10, 2003, at C3.

[156] *See* Ratner, *supra* note 146, at 1D (describing travails of one sophisticated user who was unable to activate his installation).

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

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

[159] *See supra* note 17.

[160] *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).

[161] *See 321 Studios Ends Operations*, N.Y. TIMES, Aug. 5, 2004; 321 Studios v. Metro Goldwyn Mayer Studios, Inc., 307 F. Supp. 2d 1085 (N.D. Cal. 2004); Paramount Pictures Corp. v. 321 Studios, 2004 WL 402756 (S.D.N.Y. 2004).

3. DIVX DVD Format

The DIVX format for DVD movies[162] 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 consumer electronics retailer Circuit City. The system allowed the user of a DIVX disk to view it as many times as desired, but only within a set period of time, usually 48 hours, after the initial viewing.[163] The DIVX player was connected to a central server via the telephone line, enabling the user to re-activate a disk for additional viewing time, or to remove the viewing restriction entirely, upon payment of a fee.

Introduction of the format gave rise to an anti-DIVX movement, which flowered in the form of websites urging consumers not to buy the disks. Several constituencies opposed DIVX, including competitors of Circuit City, video rental stores, and content owners that favored video-on-demand.[164]

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.[165] In June 1999, Circuit City announced that it was discontinuing the format.[166]

A variant on the DIVX concept has recently hit the market, in the form of self-destructing DVDs. The disks begin to degrade after being exposed to the air, and become unusable after 48 hours.[167]

4. Copy Protection on Music CDs

In the past few years record labels have been experimenting with implementing copy protection TPMs with their music CDs, with mixed results. There were some early missteps — some TPMs made CDs unplayable in computers and in automobile CD players, and even damaged computer CD drives,[168] while others were easily

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

[163] *See The Origins of the Original Divx*, www.g4techtv.com/techtvvault/features/35912/The_Origins_of_the_Original_Divx.html (Jan. 17, 2002).

[164] *See The Origins of the Original Divx, supra* note 163.

[165] *See DVD Frequently Asked Questions (and Answers)*, www.dvddemystified.com/dvdfaq.html.

[166] *See DIVX Bites the Dust*, hometheater.about.com/library/weekly/aa062199.htm (June 21, 1999).

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

[168] *See* Howard Cohen, *Compact Risk*, MIAMI HERALD, July 1, 2002, at —.

circumvented.[169] Copy-protected CDs were not well received in Japan, prompting Sony Japan to discontinue copy protection, and independent label Avex to reduce its use of the technology.[170] Sony's move has been ascribed to discontent by its customers, who found that the TPM prevented them from ripping songs into MP3 format so that they could be played on portable MP3 players.[171]

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 technology allows a certain number of copies to be made, which enables users to create portable MP3 files. The record labels view the new approach as a compromise, which makes the TPM more palatable to consumers while still preventing unlimited copying.[172]

B. Factors Influencing a Publisher's TPM Calculations

The experience with TPMs recounted above suggests several factors that go into determining the recovered demand, alienated demand, and total cost associated with the implementation of a TPM. It is apparent that a publisher's decision whether to implement TPMs depends upon several factors 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.

The degree of competition. As already noted, the existence of close substitutes has the effect of decreasing recovered demand and increasing alienated demand, shifting the marginal revenue curve down and therefore disfavoring the use of TPMs. The existence

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[169] One technology could be neutralized by marking the rim of a 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 was 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 24, 2004, at — (quoting CEO of TPM-maker describing the shift-key workaround as a feature, not a bug).

[170] *See* McClure, *supra* note 131, at 41.

[171] *See Angry Consumers Prompt Sony Music to Drop CD Copy Protection*, ASIA FOCUS, Oct. 1, 2004 ("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.").

[172] *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 PROF., Oct. 1, 2004, at 8 (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.").

of close substitutes is well correlated with the outcomes discussed above. Close substitutes were available for the 1980s-era software[173] and the 2002 TurboTax.[174] Windows XP and Office XP, on the other hand, lack close substitutes.[175] In the case of DIVX, the close substitute was an alternative format, DVD-Video, rather than alternative content. DVD-cum-CSS may be viewed as having a close substitute in an alternative format, VHS videotape, or as having none, since DVD has a number of features that consumers appear to value and that VHS lacks. Music CDs may be viewed as having many close substitutes, if CDs are considered individually, or as having few, if the record labels act like oligopolists.

Legal prohibition of circumvention. Since section 1201 became effective,[176] 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.[177] Thus, the 1980s copy protection technology did not have the benefit of legal prohibitions on circumvention, while the Windows XP and TurboTax technologies did. DIVX's brief existence roughly coincided with the effective date of section 1201, and it probably did not benefit from the anti-

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[173] *See* Samuelson, *Why*, *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 135, at F13 ("There now is so much great software around in nonprotected form that a buyer has no need to buy copy-protected software.").

[174] *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, *Of Top Tax Programs*, *supra* note 147, at B1 (describing TurboTax and TaxCut as "nearly identical").

[175] 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, 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 preventing them from learning of 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.

[176] The prohibition on trafficking in technologies for circumventing access controls and use controls became effective in October 1998. 17 U.S.C. § 1201(a)(2), (b)(1). 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 its first triennial rulemaking on exceptions from this prohibition. *Id*. § 1201(a)(1).

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

circumvention rules. DVD-Video was born in the pre-section-1201 era, but has spent most of its life in that era.

Ease of circumvention. Ideally, a TPM will be unhackable. In reality, any TPM can be circumvented, some at a greater and some a lesser cost.[178] The less effective a TPM is in preventing unauthorized use, the closer to the vertical axis the recovered demand curve will tend to remain. This will cause the marginal revenue curve to shift downwards, making conditions less favorable for implementing the TPM.

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

The annoyance factor. TPMs vary in the extent to which they interfere with a consumer's use of the associated information product. Some TPMs are intentionally more restrictive than others. Thus, music files downloaded from iTunes may be played on up to five playback devices,[179] while Adobe eBooks are tethered to two machines;[180] 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 product, as long as it was used for backup purposes only,[181] yet anti-copy TPMs prohibit copying altogether. A product activation technology that requires the user to contact the publisher to reactivate the product each time she installs a new piece of software on her computer causes more non-productive usability problems than a technology that requires re-activation only with significant changes in hardware configuration.

An ideal TPM would never malfunction. In the real world, a TPM will sometimes interact unpredictably with the equipment that is used to view or hear the product, as for example when copy-protected music CDs cannot be played in the CD-ROM drive of certain computers.

The greater the annoyance factor a TPM presents, the more its use will increase the alienated demand, and the more the marginal revenue curve will shift downwards. In addition, a higher annoyance factor means the publisher will incur higher costs providing

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[178] 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.

[179] *See Share Easily. Stream Wirelessly.*, www.apple.com/itunes/share.html.

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

[181] *Contra*: Former MPAA head Jack Valenti is reported to have said, "If you buy a DVD you have a copy. If you want a backup copy you buy another one." Quoted in Anick Jesdanun, *DVD-Duplication Software Maker to Modify Products*, SAN JOSE MERCURY NEWS, Feb. 24, 2004, at 3.

technical support to its customers, which will shift the marginal cost curve upwards. 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. The Windows XP and TurboTax activation technologies seem to create usability problems for only a small segment of users: those who change their hardware after activation. DIVX apparently created no usability problems.

Extent of unauthorized use. The outcome of the publisher's calculations will depend upon 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 there is, 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.

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 TPM was the focus of a great deal of publicity due to the bad print it received from Walter Mossberg and other journalists. The TPMs discussed in the other case studies have achieved varying degrees of salience.

The third-party factor. TPMs vary in the extent to which their success depends upon 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 it 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 disks, and retailers (with which Circuit City was in competition) cooperated by selling the players and disks. By contrast, the other TPMs considered in the case studies were promoted by the publishers of the relevant information goods, which prevented that group from forming a nay-saying third party. Copy protection schemes applied to software and music CDs required no third-party cooperation, as they work on existing hardware. The Content Scramble System required the co-development of compliant hardware, but the movie studios avoided a roadblock here by engaging with the consumer electronics and personal computer industries early in the process of developing the CSS standard.[182]

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[182] *See* Trial Transcript at 476-80 (Testimony of Marsha King), 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), *available at*

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, or predict whether a proposed TPM implementation will succeed? If we tabulate these factors for each of the case studies described above, we find they offer modest predictive value.

In the following table, 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 those for TurboTax do not fit the expected outcome. The entries for the other case studies are inconclusive.

The absence of strong predictive power of the model is not surprising. A publisher's decision concerning 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 wish to maintain its reputation as a consumer-friendly enterprise, as indicated by its publication of an open letter of apology, and by the fact that it dropped the TPM despite the fact that it apparently yielded significant short-term financial benefits.[183] In addition, there is no reason to think that all of the factors should receive equal weight. The fact that TurboTax had a strong rival in TaxCut, and that the publisher of TaxCut sought to capitalize on Intuit's distress by luring its customers away in a campaign focusing on the fact that TaxCut was TPM-free, might have been enough to overwhelm all 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 it is possible to derive from modeling TPMs as a price increase. Several of the empirical factors described above in text (and set out in the above chart) lie within the publisher's control, to a greater or lesser extent. A publisher can improve the benefits 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 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) engage early with relevant third parties to prevent them from hindering successful deployment of the TPM. We may also anticipate that designers of TPMs will strive to improve the technology by making them less easily circumventable and reducing the annoyance factor.

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http://www.eff.org/IP/Video/MPAA_DVD_cases/?f=20000719_ny_trial_transcript.html.

[183] *See* Baertlein, *supra* note 150, at C1 (reporting that TurboTax sales increased by 25 percent over the previous year for the calendar quarter ending in April).

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.[184] Enterprises that make frequent hardware changes to their computers will experience a higher level of annoyance than home users, since they are more likely to need to go through the process of contacting Microsoft to reactivate; and 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.

[184] *See* Scott Spanbauer, *XP's Gotchas: Windows XP Is Selling Briskly, But the Patch Parade Is Already in Full Swing*, PC WORLD, Jan. 1, 2002, at 16.

	Competition	Legal prohibition	Ease of circumven-tion	Annoyance factor	Extent of unauthorized use	Salience factor	Third party factor	Result
1980s software	–	–	–	–	+	?	+	Implemented and then withdrawn.
Windows XP	+	+	+	+	+	?	+	Implemented.
TurboTax	–	+	+	+	+	–	+	Implemented and then withdrawn.
DVD CSS and UOP	?	–, then +	+	+	+	?	+, –	Implemented.
DIVX	–	–	+	+	–	?	–	Implemented, then quickly withdrawn.
Music CD copy protection	?	+	?	?	+	?	+	Implemented unevenly; still in experimental stage.

Conclusion

The model developed in this paper reflects the fact that the dynamics of a publisher's decision whether to incorporate TPMs in its products differ from those that a firm uses in making price or output decisions, despite the fact that both aim at profit maximization. Addition of TPMs cannot accurately be modeled as either a price rise 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 in implementing them publishers incur costs in order to make their products less desirable to 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 implementation of a TPM.

The shapes of the relevant curves are affected by a variety of contextual factors, which emerge from several case studies involving implementation of TPMs. As in the context of price 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, suggest that profit-maximizing publishers that face competition have meaningful incentives to be responsive to consumer preferences concerning TPMs. Publishers in markets that are monopolistic, monopolistically competitive, or oligopolistic experience correspondingly less pressure from consumer preferences.